FINISHING PROCESSES

NORTON

10/6 NETT

6240-186

62/$55

FINISHING PROCESSES FOR COTTON FABRICS

Finishing Processes
FOR
Cotton Fabrics

By
DAVID G. NORTON, B.A., A.M.I.C.E.

Published by
SIR JAMES FARMER NORTON & CO., LTD.,
ADELPHI IRON WORKS,
SALFORD, MANCHESTER

ALL RIGHTS RESERVED.

PREFACE.

THIS small book is written with the object of describing in outline the various processes and the machinery in common use in Bleaching, Dyeing, Printing, and Finishing Cotton Fabrics. Many improvements on the machinery referred to and special apparatus connected therewith are not explained in the text or shown in the illustrations. It is not intended to deal with the chemical details of the many operations, as there are several reliable technical books already published for this purpose.

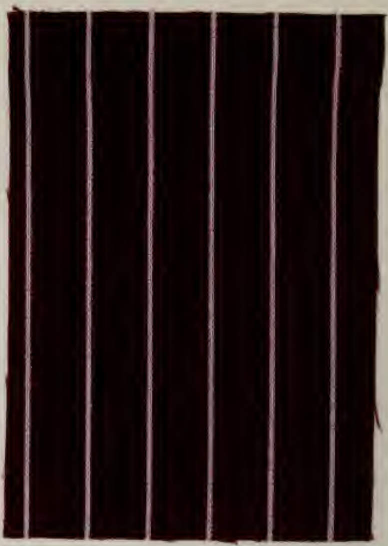
David G. Norton.

CONTENTS.

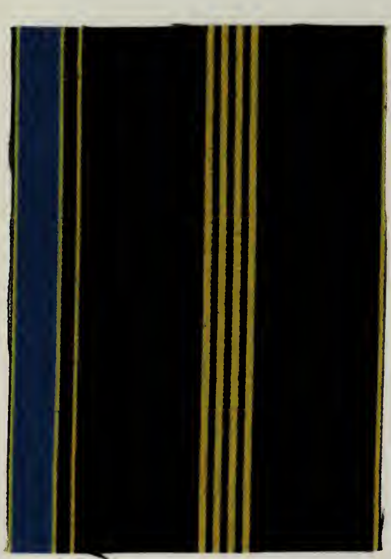
PAGE
Samples of Cloth finished by Typical Processes 4–5
Bleaching in Rope form 6–31
„ Open Width 32–38
Mercerisation of Cotton Piece Goods 41–45
Finishing of White Goods 46–65
Dyeing of Cotton Piece Goods 66–80
Printing Cotton Piece Goods 83–101
Finishing of Cotton Piece Goods 102–121
Making-up and Packing 121–122
List of Illustrations 125–126
Index 127–129

Samples of Dyed and Printed Cloth finished by Typical Processes.

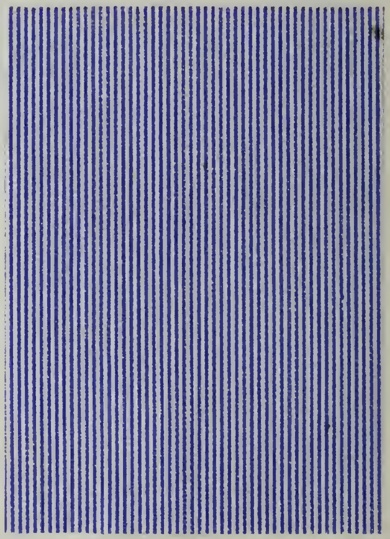
Mercerised, dyed Copper Aniline Black and Schreiner finished.



Dyed Para Red, discharged with Hydrosulphite (Rongalite).



Mercerised, dyed Steam Black with printed Yellow and Blue resists.



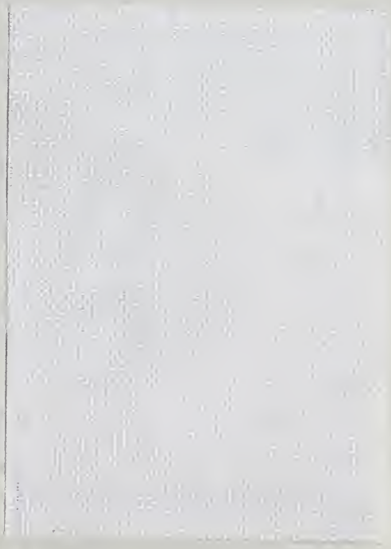
Printed Ultramarine Blue, back filled and finished on a friction calender.

Samples of White Cloth finished by Typical Processes.

Conditioned and Chased on a 7-bowl calender.

Jig Stenter, Elastic Finish.

Back Filled on "Tommy Dodd" and lightly swizzed on a 3-bowl calender.



Conditioned and Beetled.

Bleaching

THE object of Bleaching is to get rid of impurities which the cloth has gathered in the spinning and weaving operations; to remove its natural grey colour, and to leave it colourless or white. The degree of whiteness depends on what is required in the finished state of the cloth, whether it is to be white or dyed in light or dark shades.

The mechanical and chemical processes vary also according to the results required.

The cloth is delivered to the Bleach Works in its original state from the loom, and treated in the following manner :

Grey Room. After the goods have been classed in the Grey Room according to quality, and stamped or marked, they are sewn together, end to end, by Sewing Machines specially constructed for this purpose (see Fig. 1).

Singeing Methods. The cloth is then taken to the Singe House. The object of singeing is to remove the short fibres from the grey cloth, so that when it is finished it will have a clean surface. The cloth is first passed over one or more steam-heated copper cylinders to remove the moisture and to raise the nap.

Singeing is done either on a Hot-Plate Singeing Machine or on a Gas Singeing Machine. Some qualities, such as heavy Venetians and Sateens, are more successfully singed on a Plate Singeing Machine, but for most goods gas singeing is preferable. Where

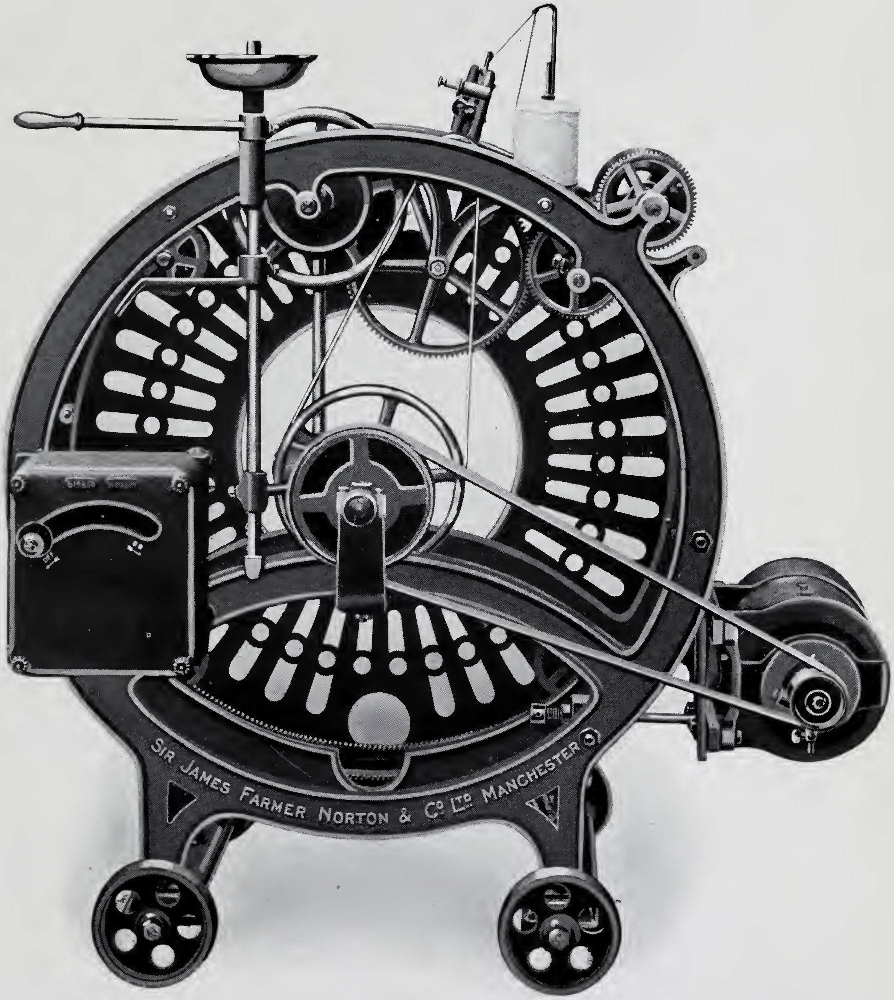


Fig. 1

Sewing Machine.

(The method of driving varies according to local conditions).

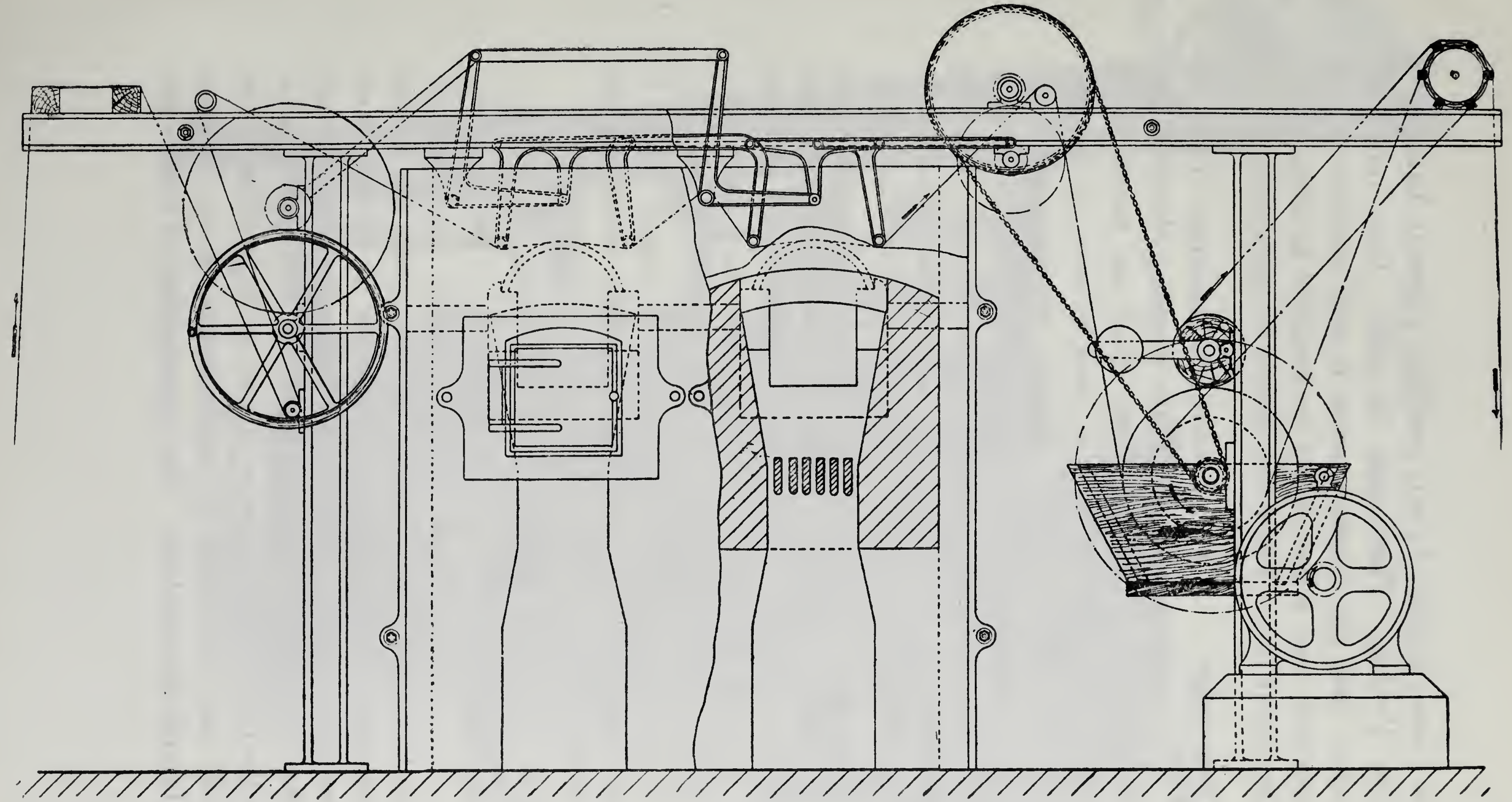


Fig. 2
Double-Plate Singe Stove.

no town's supply of gas is available a special Anthracite Gas Producer Plant may be used. Care must be taken that the singeing room is well ventilated and spacious, and a fan should be installed to draw away the burnt lint. The room should be made fire-proof.

Plate Singe Stove.

Fig. 2 shows a standard Farmer-Norton Plate Singeing Machine. It consists of two copper plates which are heated to a bright red. The furnaces are fired by heavy petroleum oil, which is vaporised through special nozzles, by the action of steam, into a fine spray. By this method a rapid and even heating of the copper plates is obtained. Where oil is not available, the furnaces are fired by coal or wood. The cloth passes over the plates at speeds up to about 200 yards per minute, according to quality. A special traversing arrangement for the cloth is supplied, which moves concentrically with the surface of the plates. This prevents local cooling by continually bringing a fresh hot portion of the plate in contact with the cloth. The singed cloth is immediately afterwards run through water to extinguish the sparks.

Gas Singeing Machine.

Where gas is available, a Farmer-Norton Four-Burner Gas Singeing Machine, Fig. 3, may be employed. In this machine gas and air are fed into the special burners. Slit openings are provided in these burners on which an even flame of the Bunsen type burns over the full width of the cloth, and the width of flame is adjustable. Cloth can be singed on both sides or one side only, according to requirements, in one passage through the machine. The consumption of town's gas

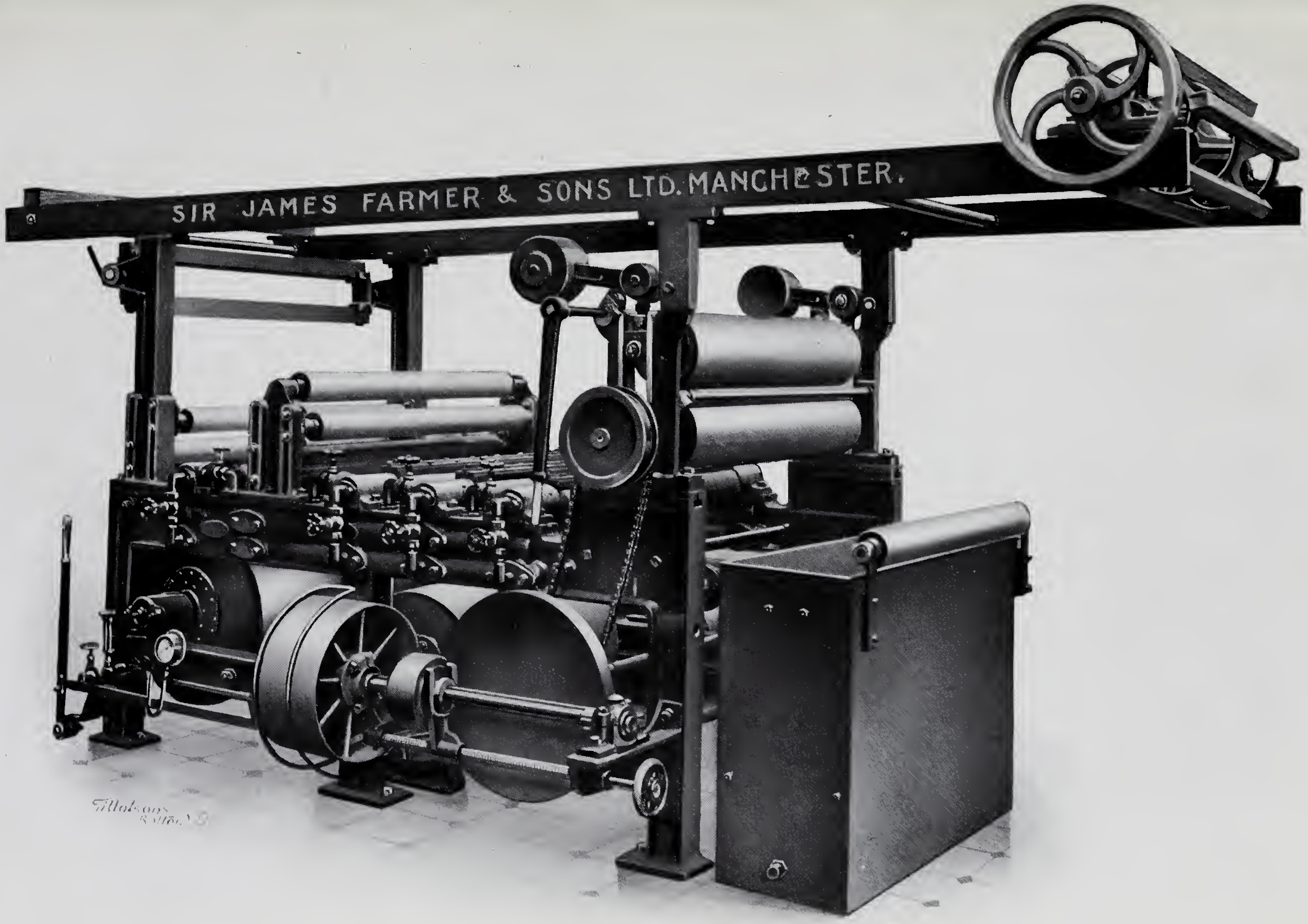


Fig. 3
Gas Singeing Machine.

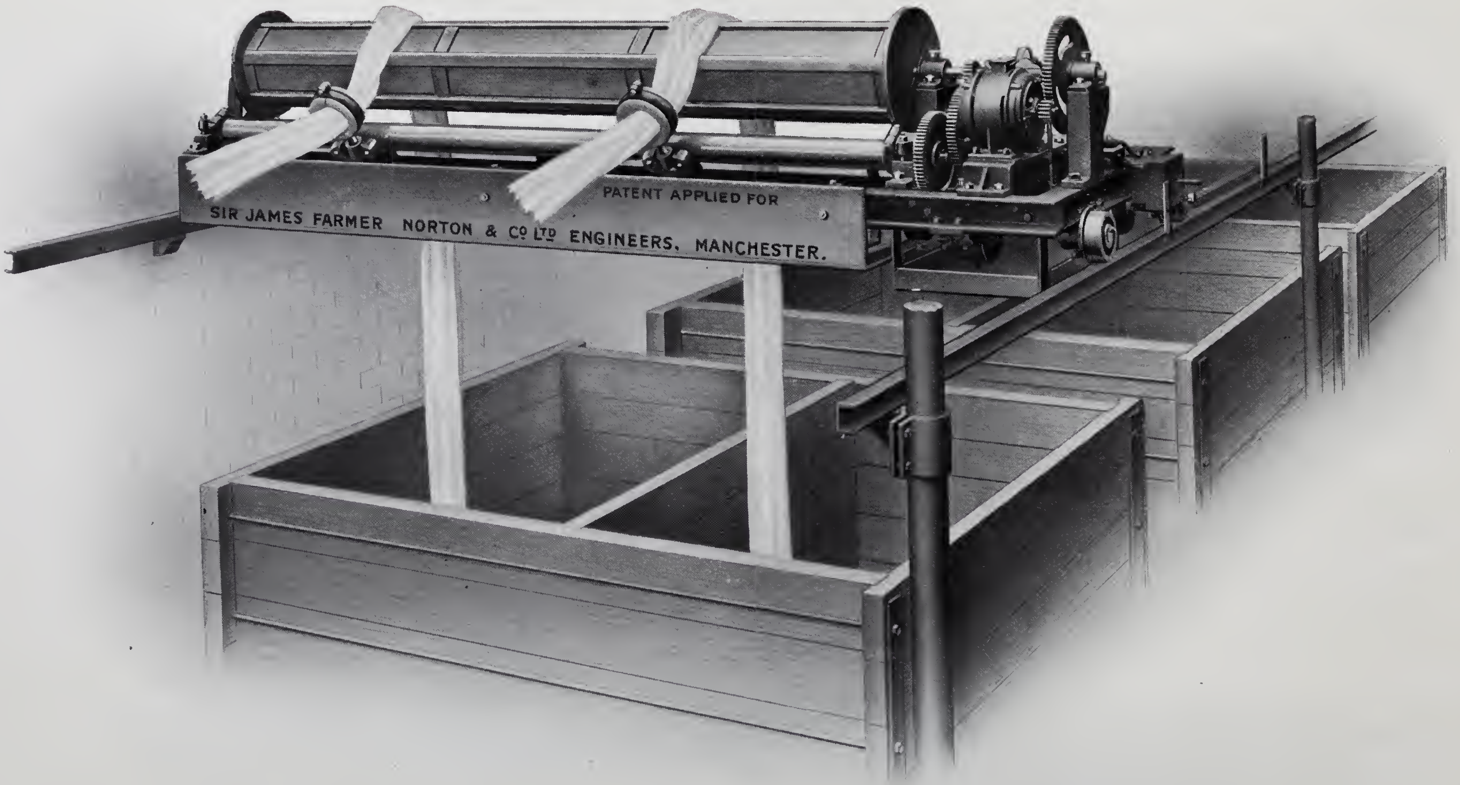


Fig. 4
Patent Electrically-operated Automatic Cloth Piling Apparatus.

on a Four-Burner Gas Singeing Machine is about 30/36 cubic feet per foot wide of flame per burner per hour. When using suction gas produced from anthracite, four times the above quantity is required.

After singeing, the cloth passes through water, as in the Plate Singeing Machine, and is piled down by boys into pits, where it is allowed to steep for some hours. Certain impurities in the cloth are removed by this steeping operation.

Automatic Piling. Considerable skill, time and labour is required to form an even and regular pile of cloth by hand work, but piling can best and most expeditiously be done by means of a Farmer-Norton Automatic Electric Piler (see illustration, Fig. 4). It consists of a carriage mounted on wheels, which runs on rails over the pits in a longitudinal direction and is driven by a small electric motor. Another small electric motor rotates the feeding wince and gives a cross traverse motion to the porcelain rings, called " pot eyes," which guide the cloth in rope form over the wince. The length traverse motor has a reversing switch, operated by stops fixed to the rails, so that when the carriage reaches the end of the pit its direction is reversed. The combined backward and forward motion of the carriage and the lateral traverse of the guide " pot eyes," cause the cloth to be piled in successive folds laid side by side in the pits. When the first series of pits is full the carriage runs over the next series of pits, and the piling operation is repeated until all the pits are full. This Automatic Piler will pile into any number of pits at speeds up to 250 yards per minute and will form a more even pile than it is possible to produce by hand.

Bleach-croft Operations. After the cloth has been allowed to lie in the pits for some time, it is drawn through the " pot eyes," in rope form, into the Bleach-croft, where it undergoes the various operations of saturating, boiling, souring, chemicking, etc.

The cloth may first be run through a Farmer-Norton Bleach-croft Washing Machine, Fig. 7, to saturate it, and, as in all Bleach-croft Machinery, two ends of cloth are fed into the machine.

Kier. The cloth is then run into the High-pressure Kier, Fig. 6, for boiling, in order to remove fatty matter and sizing ingredients. Revolving winces feed the cloth into the Kier in two ropes, one through each manhole, where it is piled down inside by boys. Fig. 5 shows a Kier with a central manhole. The two strands of cloth are both fed through this central manhole and this method is preferred by some bleachers as being more convenient. Wooden clogs should be worn by all workers in the Bleach-croft to prevent iron stains. When the required quantity of cloth has been fed into the Kier, the manhole-covers are screwed down and sufficient lye is run in to cover the cloth. The air is expelled and the boiling lye is circulated by a pump through the external multitubular heater (see Fig. 6). A certain time is necessary to saponify the fatty matter in the cloth, which remains in the Kier about six to eight hours. After boiling, the lye is run off and the Kier immediately filled with cold water.

Methods of Kier Boiling. The liquor used in the Kier varies according to the subsequent requirements of the cloth. Generally speaking, there are two methods of Kier boiling : a

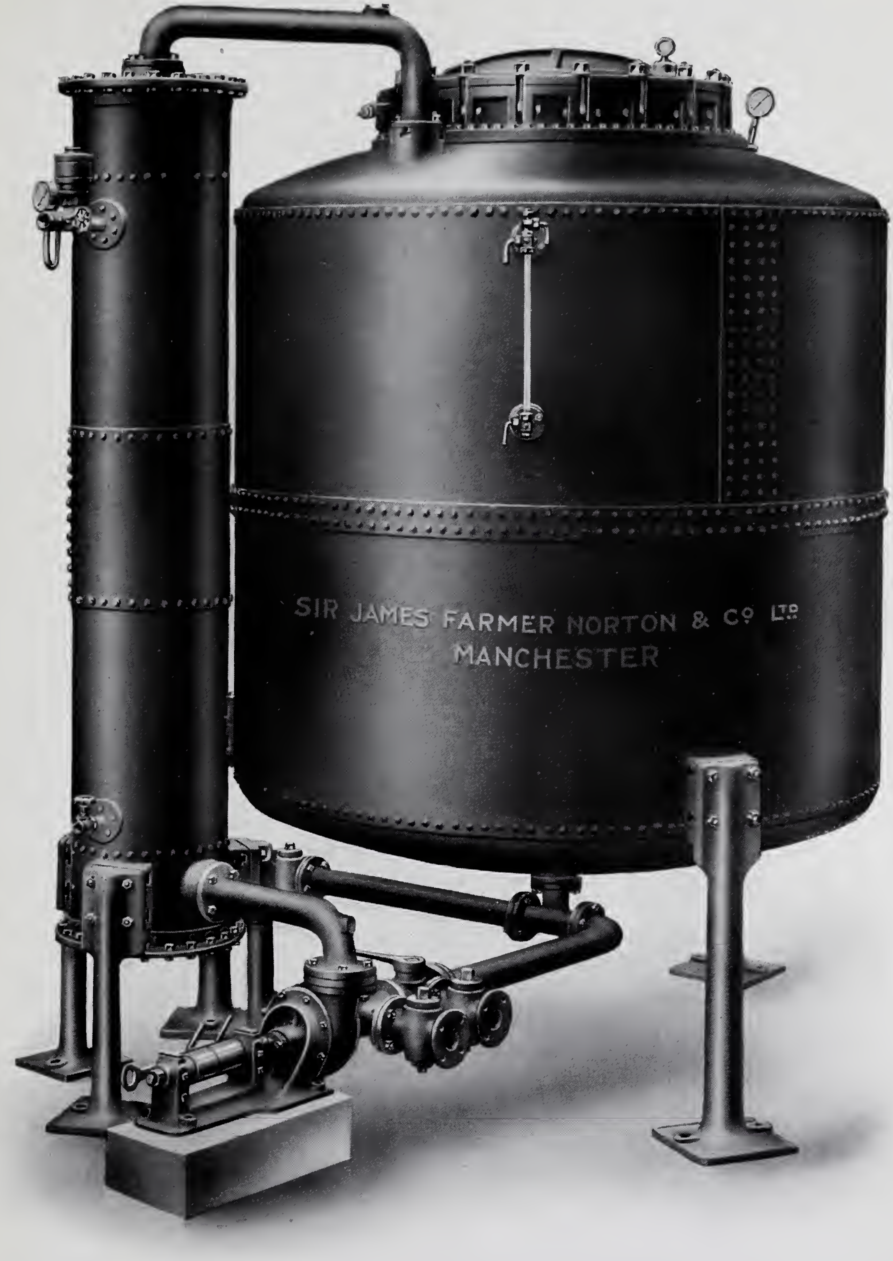


Fig. 5
High-pressure Kier with Central Manhole.

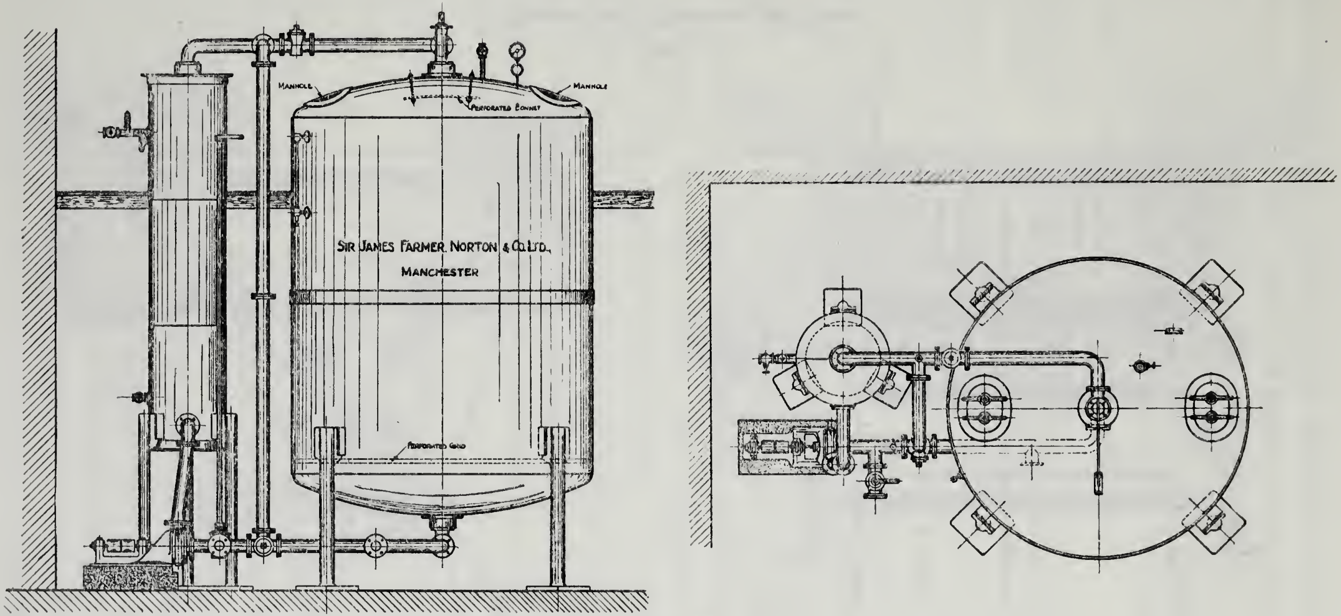


Fig. 6

High-pressure Kier with Multitubular Heater and Two Manholes.

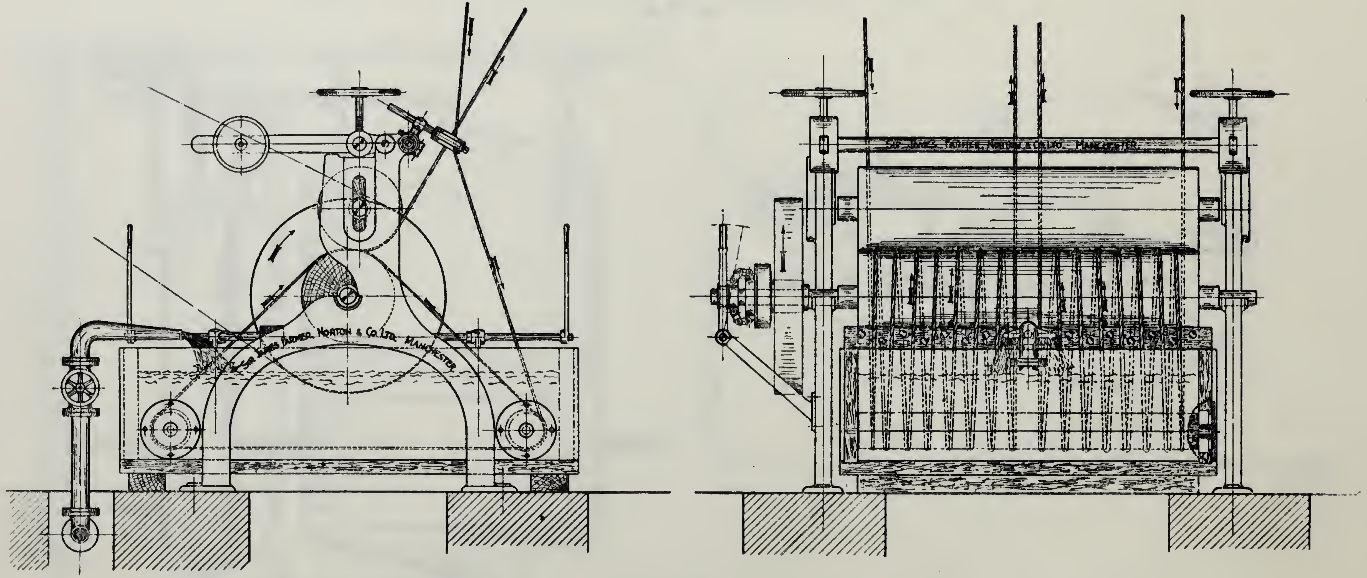

Sir James Farmer, Norton & Co. Ltd. Manchester
Sir James Farmer, Norton & Co. Ltd. Manchester

Fig. 7
Bleach-croft Washing Machine.

single boiling, in which strong caustic soda is used; and a double boiling, one with lime, and a second with soda ash. The caustic soda, or single boiling bleach, is generally used for dyed goods. For whites, and where the cloth needs to be thoroughly bottomed, the double boiling process is usually adopted.

Bleach-croft Washing. In the single boiling process, the cloth is usually saturated in the Washing Machine with hot caustic soda and run direct into the Kier. It is boiled and given a short wash in the Kier, and is then washed in the Bleachcroft Washing Machine, Fig. 7. The cloth is guided in two ropes on to the two beech bowls of this machine through " pot eyes," one at either end, and passes round two wood rollers in a water box, running spirally through the machine to the centre (see diagram.) Each rope leaves the machine at the centre. A peg rail is provided to guide the ropes of cloth through the machine. A strong douche of water plays on the cloth at the point where it leaves the machine, and gives it a final rinse.

Chemicking and Souring. After the Kier boiling, the next operations are the chemicking (chloring) and souring (*i.e.*, neutralising of the alkali by dilute acid, usually dilute hydrochloric or sulphuric acid), two methods of which are in use. By one method the operations are done in Bleach-croft Washing Machines appropriated for the purpose. By the other method the cloth is piled down into pits, and the chemic or sour is sprayed over the cloth by a pump and caused to circulate through it. For the latter method automatic piling can be used with advantage.

Bleaching Powder.

Bleaching powder (hypochlorite of lime) is generally used for the chemicking operation. The solution is prepared in a separate tank and allowed to settle, and the clear liquid is afterwards drawn off for use. A solution of hypochlorite of sodium, produced by the electrolysis of a solution of common salt, is sometimes used, especially where bleaching powder is difficult to obtain. The electrolysing plant is very simple ; the salt solution is circulated by a centrifugal pump through glass or porcelain tanks ; each tank contains a positive and negative electrode, and the electric current is passed through the salt solution until a sufficient strength of chlorine is obtained. The liquor is then run off to the supply tank for the Bleach House.

Electrolytic Bleach.

Sequence of Bleaching Operations.

The following two briefly stated methods of bleaching show the sequence of operations :—

A.

1. Marking, sewing, singeing and steeping.
2. Saturating with caustic soda.
3. Caustic soda boil.
4. Washing.
5. Chemicking.
6. Washing.
7. Souring.
8. Washing.
9. Squeeze off.

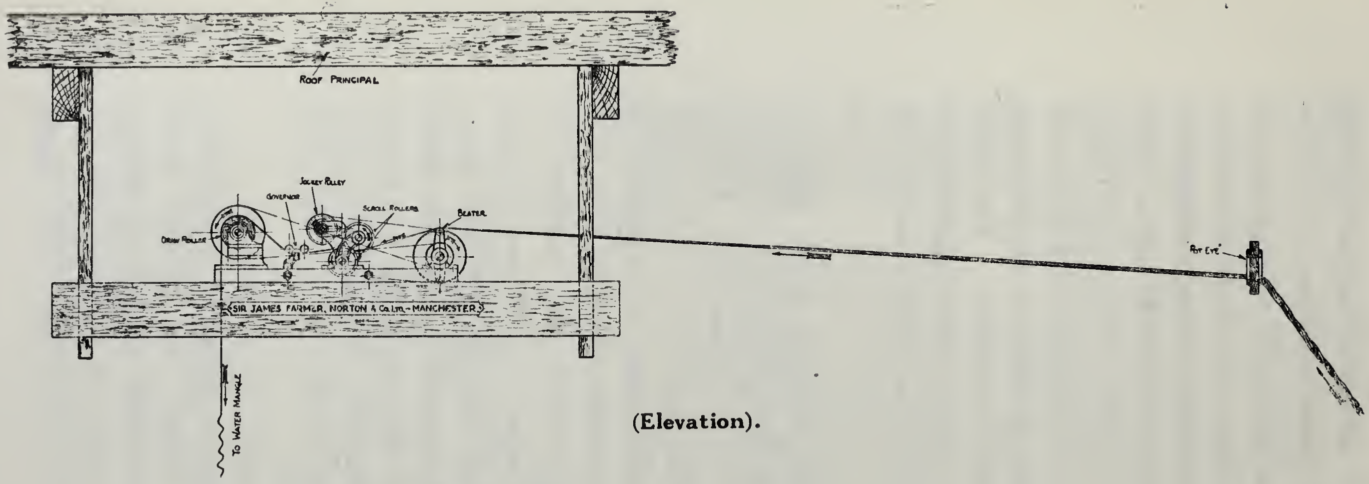
B.

1. Marking, sewing, singeing and steeping.
2. Liming and filling in lime kiers.
3. Kier boiling with lime.
4. Washing.
5. Souring.
6. Washing.
7. Soda Ash Boil.
8. Washing.
9. Chemicking.
10. Washing.
11. Souring.
12. Washing.
13. Squeeze off.

The machinery should be so arranged in the Bleach-croft that the cloth passes continuously from each machine to the next in the order of sequence of the process, from the point where the rope of cloth is drawn into the Croft from the Singe House, to the point where it leaves the Croft in its fully bleached state (see plan of works, pages 29 and 30). The only breaks in its continuous progress are during the kier boils and during the piling and steeping in the pits for the sour and chemic, when this method is adopted. The ropes of cloth are helped in their passage from one machine to another by wood-lagged winces which are placed near the roof of the Croft.

Squeezing. After the final washing in the Bleach-croft Washing Machines, the cloth, free from all traces of chemicals, is squeezed in a Squeezing Mangle, Fig. 8a, containing two bowls about 18-in. wide on the face. The top bowl is usually made of sycamore or compressed cotton or compressed cocoa-nut fibre, and the bottom bowl, through which the machine is driven, is of brass. The two ropes of cloth pass between these bowls and receive the pressure through compound levers and weights. A wood box may be fitted under the machine, in which the operation of blueing may be done if required. The cloth is then piled down in two piles and is ready for opening to its full width by the Scutcher, Fig. 8.

Scutcher. This machine is a simple contrivance consisting of a revolving beater and copper scroll opening rollers. The rope of cloth leaves the Bleach House over a horizontal length of between 20 and 40-ft. on to the beater of the Scutcher, which opens



(Elevation).

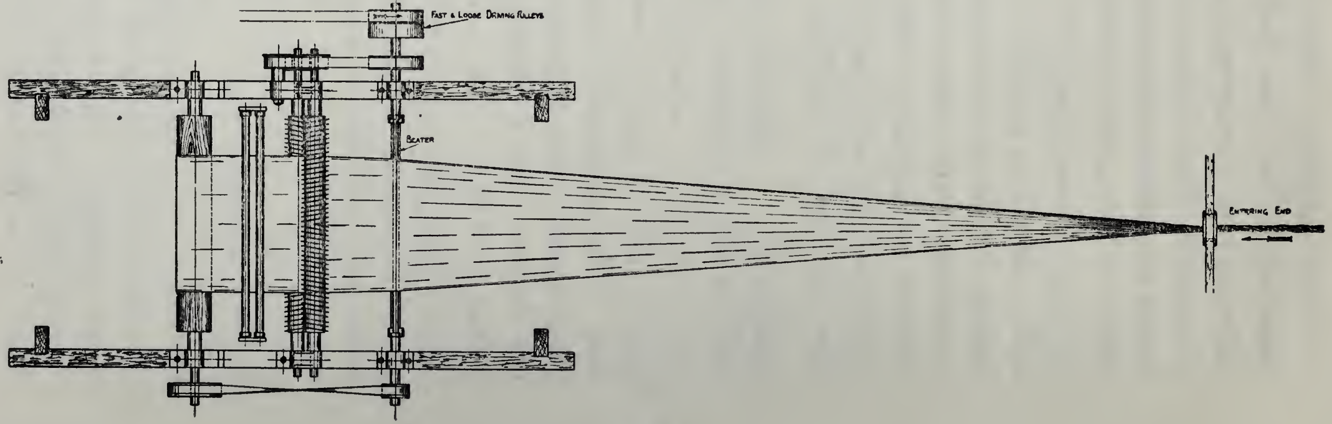


Fig. 8
Scutcher (Plan).

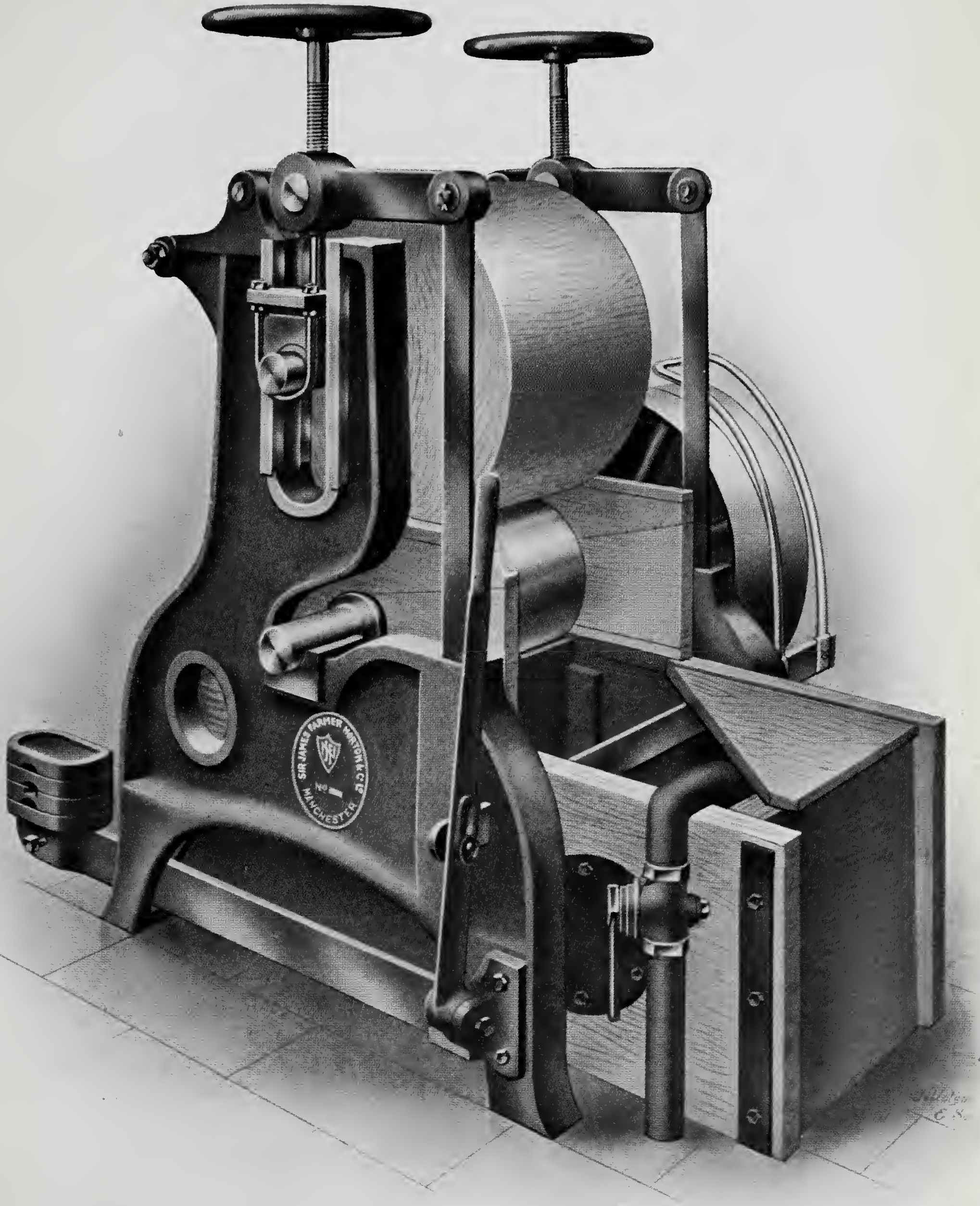

SIR JAMES FARMER NORTON & CO. LTD.
MANCHESTER
No

Fig. 8a
Squeezer.

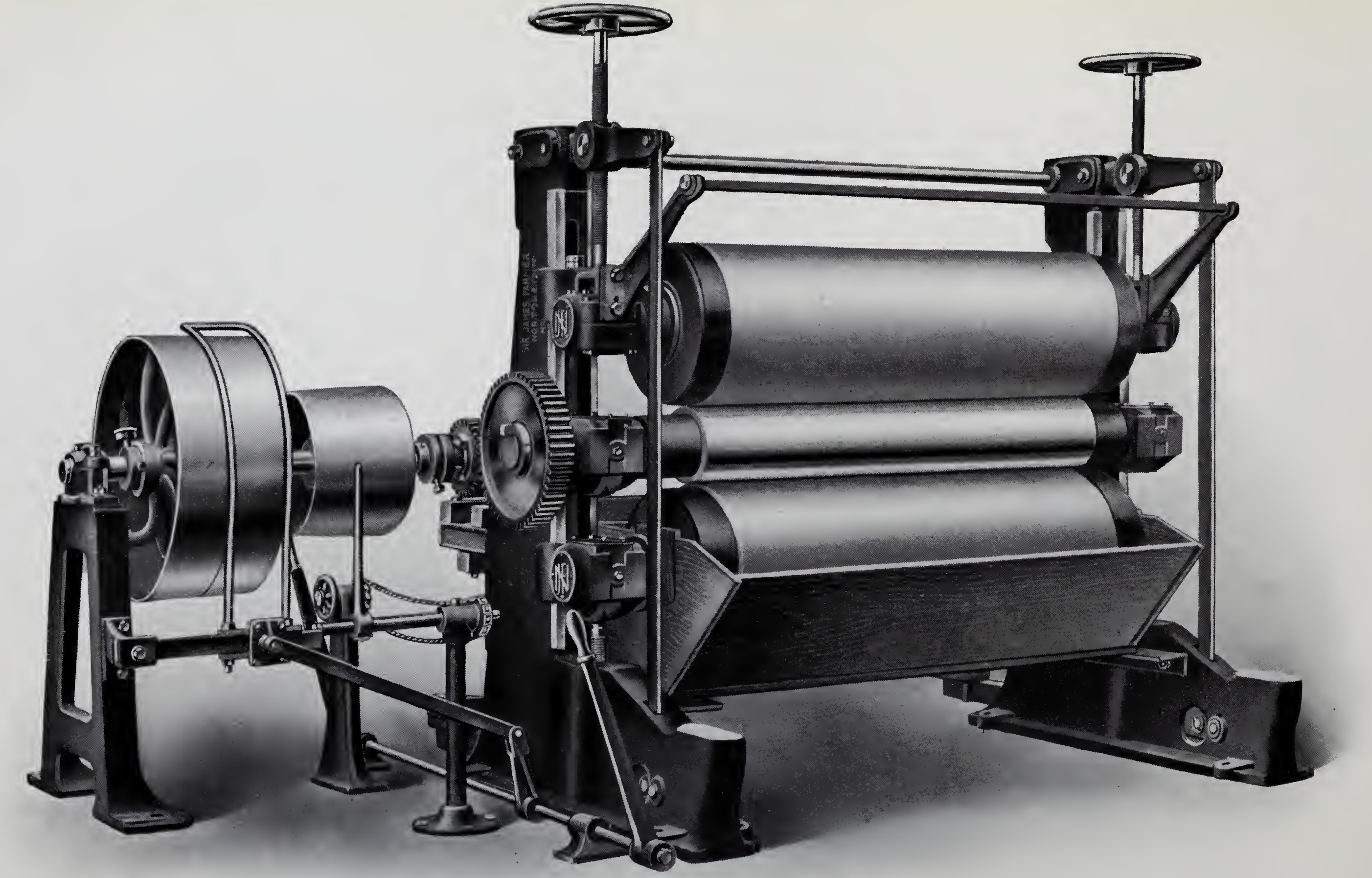


Fig. 9

Three-bowl Water Mangle

out the folds. The cloth passes between the scroll rollers, which are driven in an opposite direction to the cloth and complete the opening action. It is kept central and corrected of any tendency to wander, by means of a swivelling set of bars pivoted on the centre.

Water Mangle and White Drying Range. The cloth is delivered from the Scutcher to a Three-bowl Farmer-Norton Water Mangle, Fig. 9, consisting of two cotton or sycamore bowls and a middle brass bowl. The machine gives the cloth a heavy squeeze and removes the excess of water. From the Water Mangle the cloth is delivered direct to the Horizontal Drying Machine, Fig. 10. The Drying Machine consists of a series of steam-heated cylinders made of copper or tinned iron, driven by spur wheels from the Mangle by a variable-speed gear, such as cone pulleys. By this means the tension of the cloth between the Mangle and Drying Machine is regulated. Steam is fed through the hollow framing of the machine to the nozzles of the cylinders at one end. The condensed water formed in the cylinder is removed by a special internal bucket through the nozzle at the other end of the cylinder. This bucket is cast in one piece with the cylinder end. The condensed water passes through the hollow framing to a steam trap. Atmospheric valves are fitted to the cylinder ends to prevent a vacuum forming inside the shell and the consequent collapse of the thin cylinder walls. The cloth is dried by passing over these cylinders, and is plaited down by the plaiting-down apparatus at the end of the machine. Where it is necessary to economise space the drying cylinders are often placed in vertical stacks, Fig. 10a.

The bleaching operations already described may be varied according to the goods and the purposes for which they are intended.

Water. Good water is essential to good bleaching. The supply must be plentiful, and the softest water gives the best results. It is essential that the water be free from iron. The washing operations must be well and thoroughly done. When completed the goods are ready for Dyeing, Printing or Finishing.

NOTES ON CYLINDER DRYING MACHINES.

Assuming 80% moisture is to be evaporated from the cloth, and that the pressure of steam in the drying cylinders is 15-lbs. per square inch :—

(1) Cloth weighing less than 1-lb. per 5 square yards—each drying cylinder will dry 3 yards of cloth per minute;

(2) Cloth weighing more than 1-lb. per 5 square yards and less than 1-lb. per 2½ yards—each drying cylinder will dry 2½ yards of cloth per minute;

e.g.—A 15-cylinder Drying Machine will dry 45 yards per minute of (1) and 37½ yards per minute of (2).

If the material has been passed through a Water Mangle it will usually only contain 50% to 60% of moisture, and in this case the production will be increased in proportion.

The consumption of steam is approximately 1.5-lbs. per lb. of evaporated moisture.

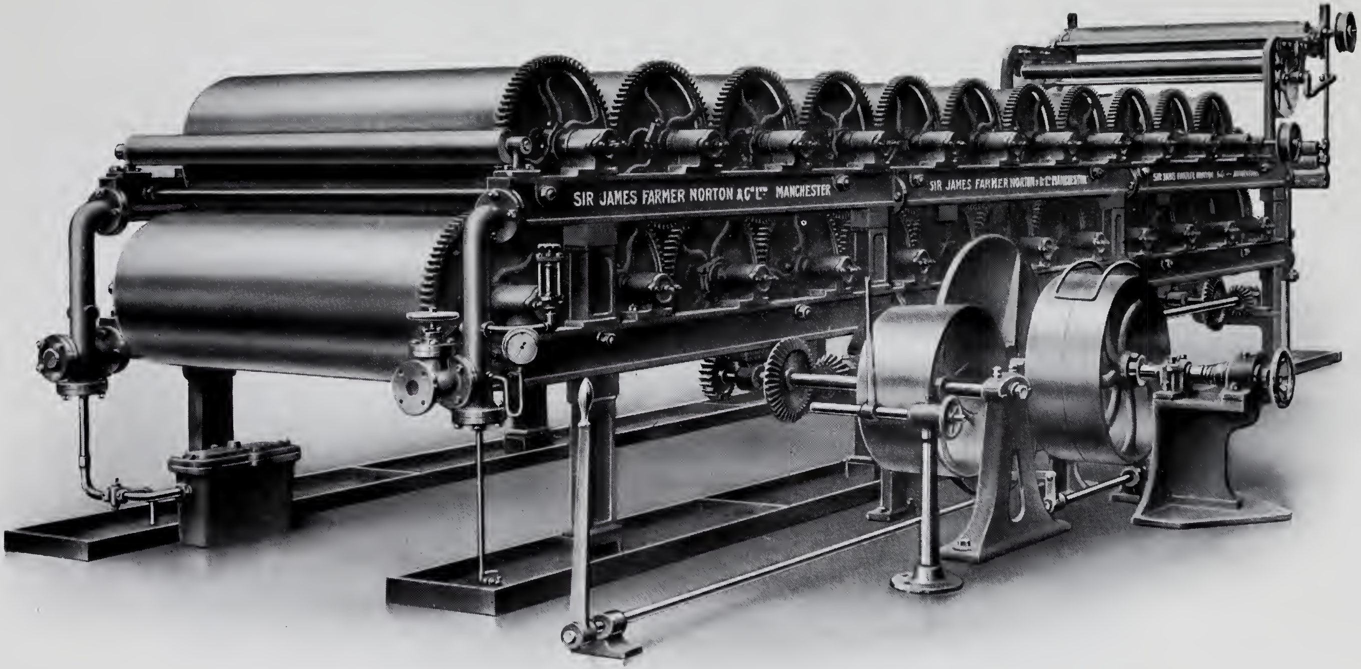

SIR JAMES FARMER NORTON & Co Ltd MANCHESTER
SIR JAMES FARMER NORTON & Co Ltd MANCHESTER

Fig. 10
Horizontal Drying Machine.

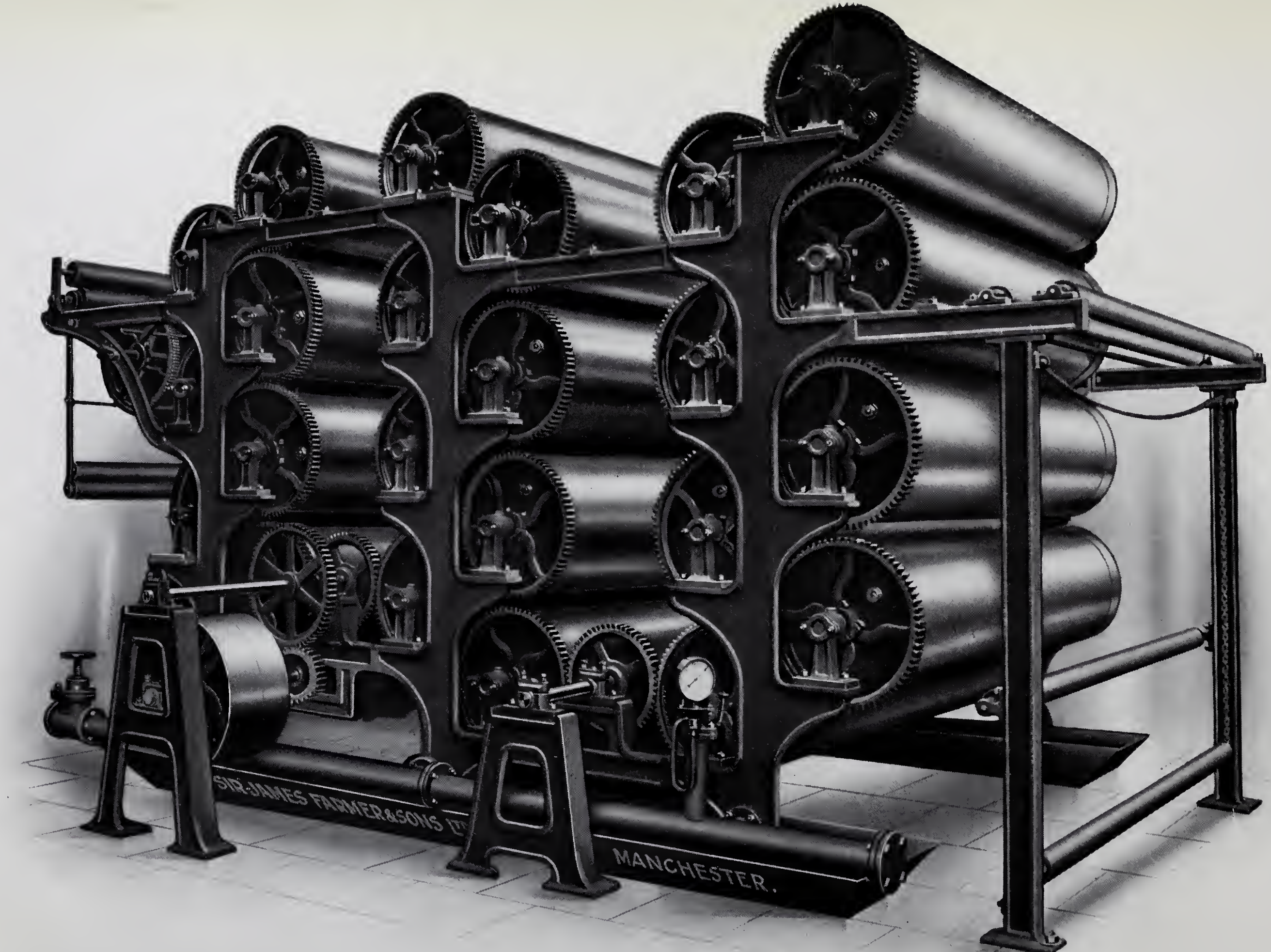
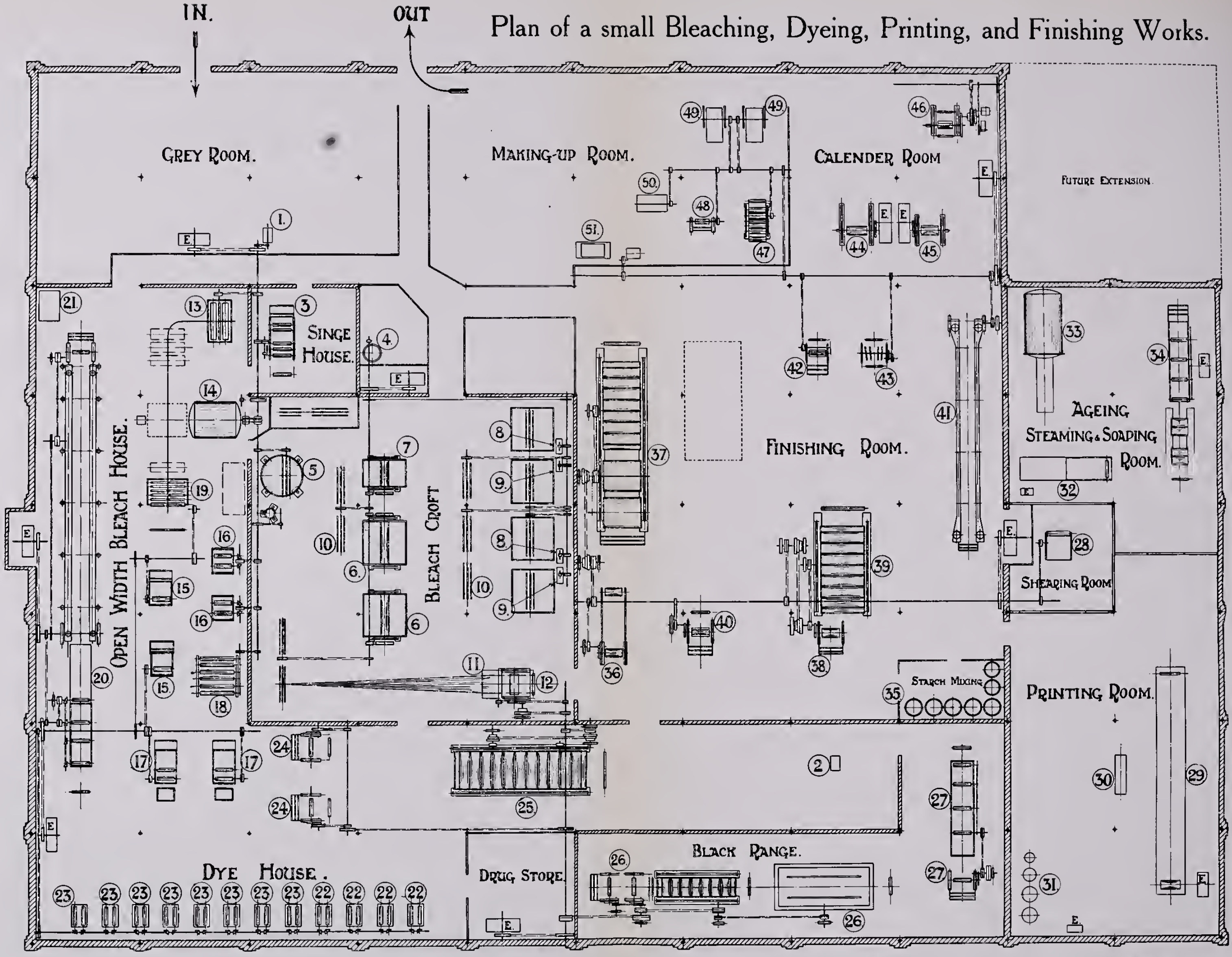


Fig. 10a

Vertical Drying Machine.

Plan of a small Bleaching, Dyeing, Printing, and Finishing Works.



Grey Room.

1. 1 Power-driven Sewing Machine.
2. 3 Portable Sewing Machines.

Singe House.

3. 1 Four-burner Gas Singeing Machine.

Bleach-croft Mixing Room.

4. 1 Chemic Mixer.

Bleach-croft.

5. 1 Three-ton High-pressure Kier, with Heater and Pumps.
6. 2 Washing Machines.
7. 1 Saturating Machine.
8. 2 Brass Centrifugal Sour Pumps and Cisterns.
9. 2 Cast-iron Centrifugal Chemic Pumps and Cisterns.
10. 14 Winces.
11. 1 Scutcher.
12. 1 Three-bowl Water Mangle.

Open Width Bleaching Room.

13. 1 Open Width Time Wheel.
14. 1 Horizontal Kier.
15. 2 Padding Machines.
16. 2 Bleaching Jiggers.
17. 2 Washing and Souring Machines.
18. 1 Cloth Stillage.
19. 1 Washing-off Machine.

Mercerising Room.

20. 1 Mercerising Range, with Steaming Chamber and Souring and Washing Tanks.
21. 1 Large Storage Tank.

Dye House.

22. 4 Sulphur Dye Jiggers.
23. 8 Ordinary Dye Jiggers.
24. 2 Dye-house Mangles.
25. 1 23-Cylinder Drying Machine.
26. 1 Copper Black Plant.
27. 1 Chroming and Washing Range.

Shearing Room.

28. 1 Four-cutter Shearing Machine

Printing Room

29. 1 Four-colour Printing Machine, with Cylinder Drying Arrangement.
30. 1 Mandril Forcing Press.
31. 4 Colour Mixing Pans.

Ageing, Steaming and Soaping Room.

32. 1 Steam Ager.
33. 1 Steaming Cottage.
34. 1 Four-tank Soaping and Drying Range.

Finishing Room.

35. Starch Mixing Tubs.
36. 1 Back Filling Mangle.
37. 1 White Drying Range.
38. 1 Two-bowl Starch Mangle.
39. 1 Dyed Goods Drying Machine.
40. 1 Two-bowl Friction Starch Mangle.
41. 1 60-ft. Non-Jig Stenter.
42. 1 Brush Damping Machine.
43. 1 Belt Stretching Machine.
44. 1 Six-bowl Swizzing and Chasing Calender.
45. 1 Three-bowl Friction Calender.
46. 1 Single Nip Hydraulic Schreiner Calender.

Making-up Room.

47. 1 Lustring Machine.
48. 1 Lapping and Rolling Machine.
49. 2 Plaiting Machines.
50. 1 Piece Goods Stamping Machine.
51. 1 Hydraulic Baling Press and Pump.

E. Steam Engines.

The horse-power required to drive a drying machine can be estimated approximately, by assuming $\frac{1}{3}$ horse-power for each cylinder, *e.g.*, 15 cylinders will require five horse-power.

USEFUL NOTES.

The average approximate output of an ordinary calico loom is 30 yards per day of eight hours.

QUANTITIES REQUIRED TO BLEACH ONE TON OF ORDINARY CALICO :—

1. Bleaching powder—1-cwt. best commercial bleaching powder.
2. Hcl. " sour "—1-cwt. commercial Hcl. 30%.
3. Caustic Soda (when using the caustic bleach)—1–1½-cwt. commercial solid caustic soda 78%.
4. Soda ash for pure white bleach—1½-cwt. soda ash.
5. Lime for ditto—½-cwt. best quick lime or ¾-cwt. hydrated lime.

The above quantities are only approximate.

THEY DEPEND UPON THE FOLLOWING FACTORS :—

(a) Time—the longer the time, the weaker the chemicals.

(b) Pressure in the kier boil.

(c) Quality of cotton.

If the bleaching liquors are used continuously, as is general, further lots require less bleaching powder.

About three tons of coal are required to bleach one ton of cloth of average weight, say five yards per lb.

The quantity of water required to bleach and finish one ton of cloth of average weight is about 40,000 gallons.

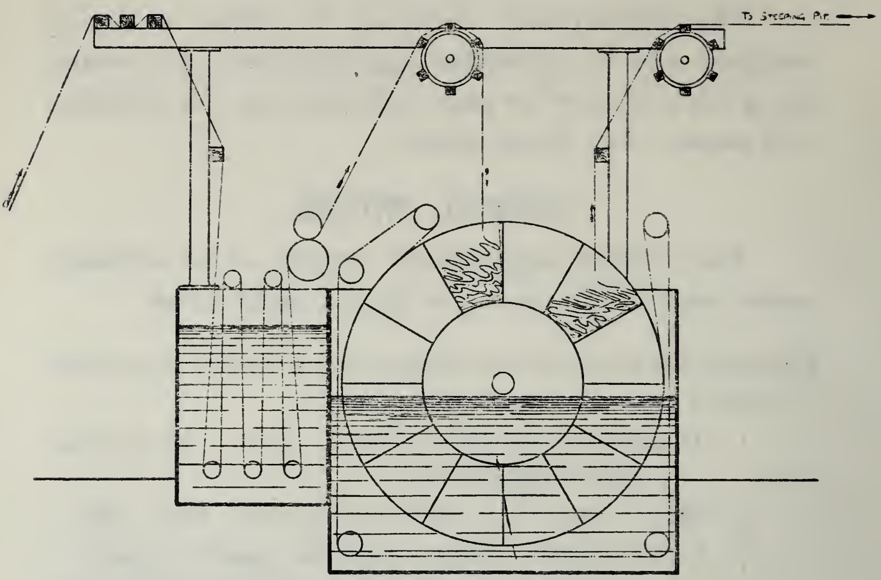


Fig. 11

Open Width Malting Tank and Time-wheel.

Bleaching in the Open Width.

Classes of Fabrics Bleached in Open Width.

Certain classes of goods such as satins, heavy sateens, repps, poplins, heavy cotton drills, etc., are usually bleached in the open width instead of in the rope form. They are liable to be damaged if bleached in the rope form, and the subsequent dyeing operations would be uneven.

Sequence of Operations.

The process in general use can be briefly described under the following headings :—

1. Marking, Sewing and Singeing, as in other types of bleaching.

2. Malting with diastase in the Farmer-Norton Patent Open Width Time-wheel, Fig. 11.
3. Steeping and Washing in open width.
4. Padding with caustic soda, see Fig. 12.
5. Plaiting down into Farmer-Norton Horizontal Kiers, Fig. 13, in open width and boiling with caustic soda.
6. Washing and Souring in open width, Fig. 14.
7. Bleaching on Jigger, Fig. 15.
8. Washing, Souring and Washing.

In the second and third operations the action of the diastase loosens the starch and size, and makes the boiling in the kier more effective.

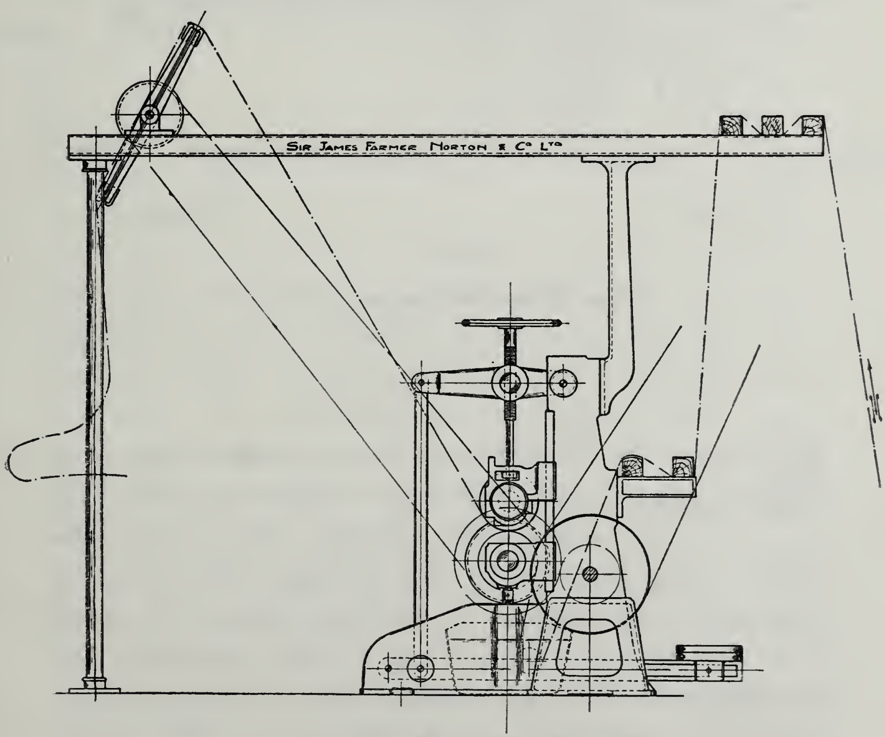


Fig. 12
Two-bowl Padding Mangle.

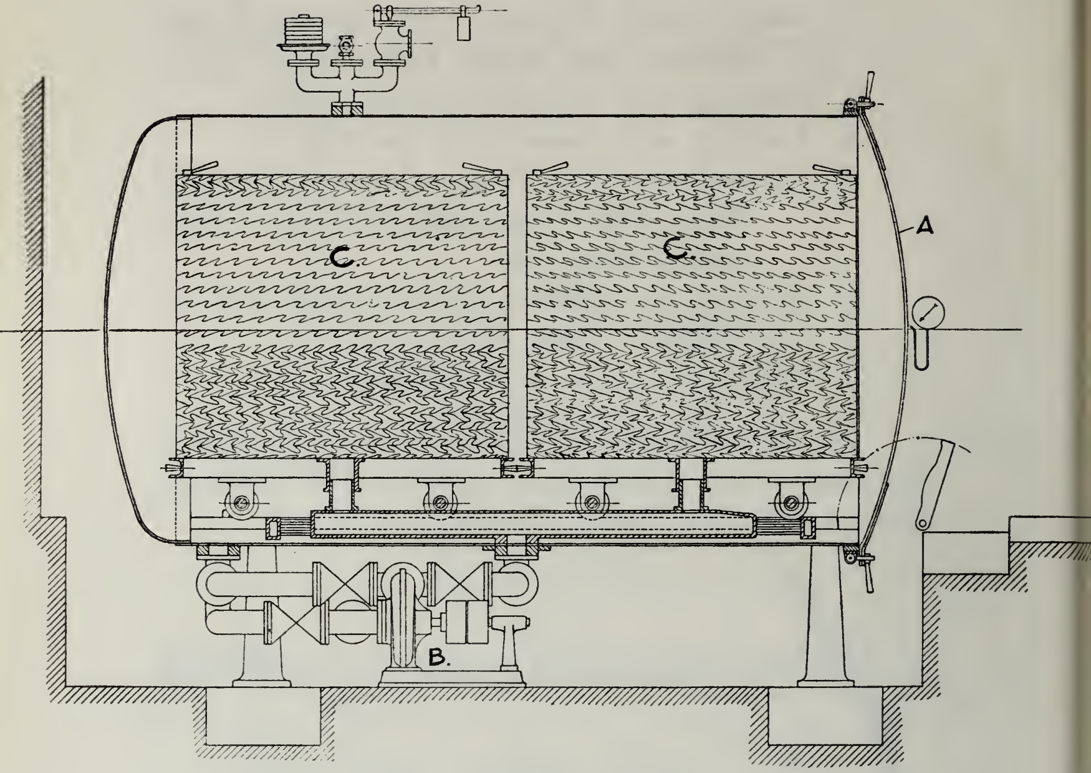


Fig. 13

Open Width Horizontal Kier.

Malting with Time-Wheel.

The Malting Apparatus consists of a malt tank with a light nip and a so-called Time-Wheel, into which the cloth is fed from an overhead wince. The cloth is saturated with the malt in the first tank, after which it is fed into the Time-Wheel, which completes one revolution in 10 to 15 minutes. This allows sufficient time for the diastase to impregnate the fabric thoroughly, so that the starch and size are loosened

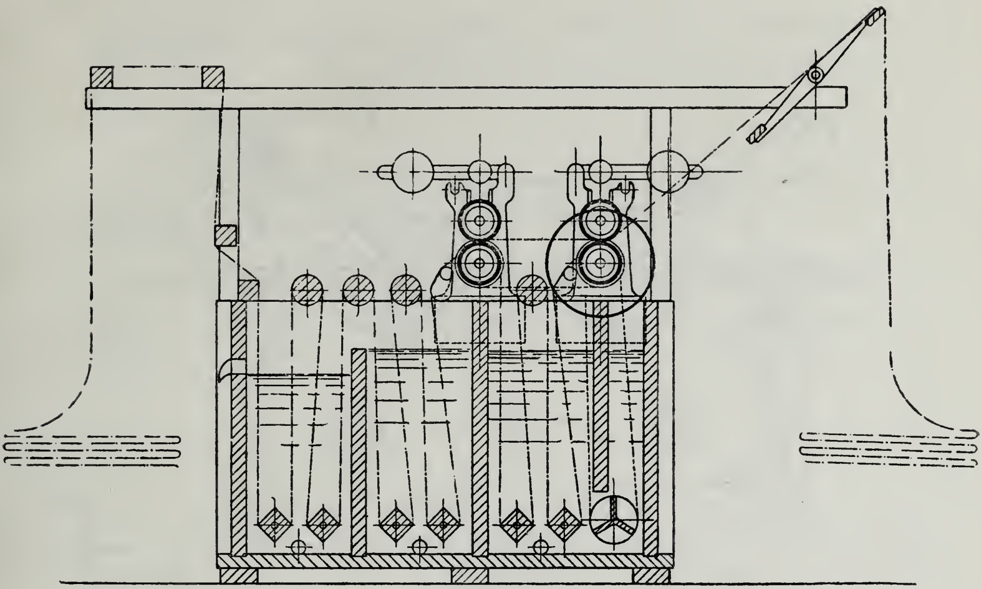


Fig. 14

Open Width Washing and Souring Machine.

after the subsequent steeping. The series of compartments on the Time-Wheel are closed by an outer endless blanket, which holds the cloth in position until the wheel has completed its revolution. Each compartment holds a certain amount of cloth. To prevent the cloth from piling on top of the division plates, the plates are made loose, being hinged to the central drum, and they fall forward as soon as they reach the vertical position at the top.

Padding with Caustic Soda. The cloth in operation (4) is padded on a Two-bowl Padding Mangle with caustic soda, see Fig. 12.

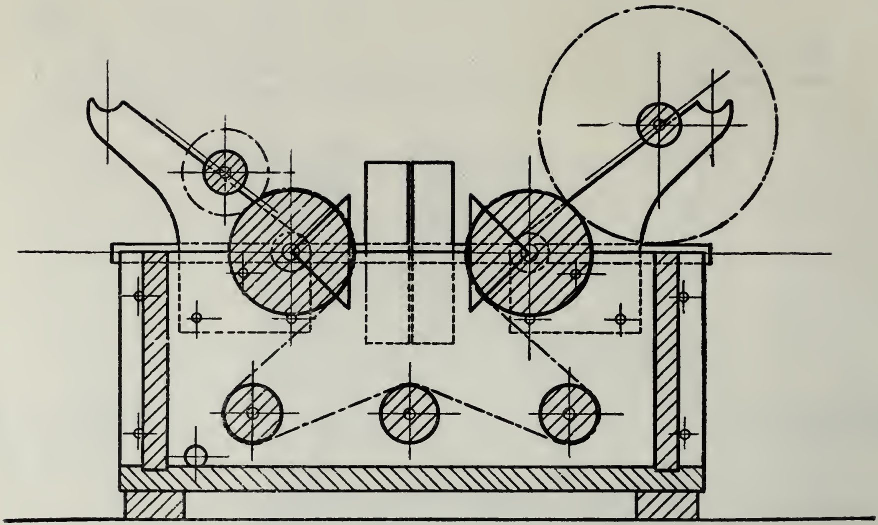


Fig. 15

Bleaching Jigger.

Open Width Horizontal Kier. The goods are then plaited down in the open width by Automatic Pilers into steel wagons, which run on lines into the specially constructed Horizontal Kiers, Fig. 13. The door "A" is closed and the caustic soda is circulated through the cloth by a centrifugal pump "B." Each kier has usually four trucks "C," two of which are being filled whilst the others are in use in the Kier. The action of the Kier resembles in most respects that of the ordinary Rope Bleaching Kier. The time taken for the kier boil is about four to six hours.

Washing Machine. The goods are then washed and soured in the Washing Machine, see illustration, Fig. 14.

Bleaching Jigger. The machine used for bleaching resembles in many respects the ordinary Dye Jigger, Fig. 15.

The final operations of washing and souring are done on a machine similar to Fig. 14.

The open width bleaching process above described varies in detail according to the class of goods to be treated.

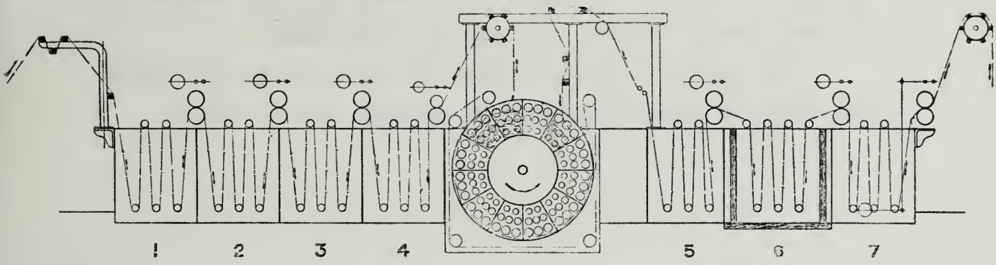


Fig. 15a

Continuous Open Width Bleaching Machine, with Time-wheel.

Continuous Open Width Bleaching Process.

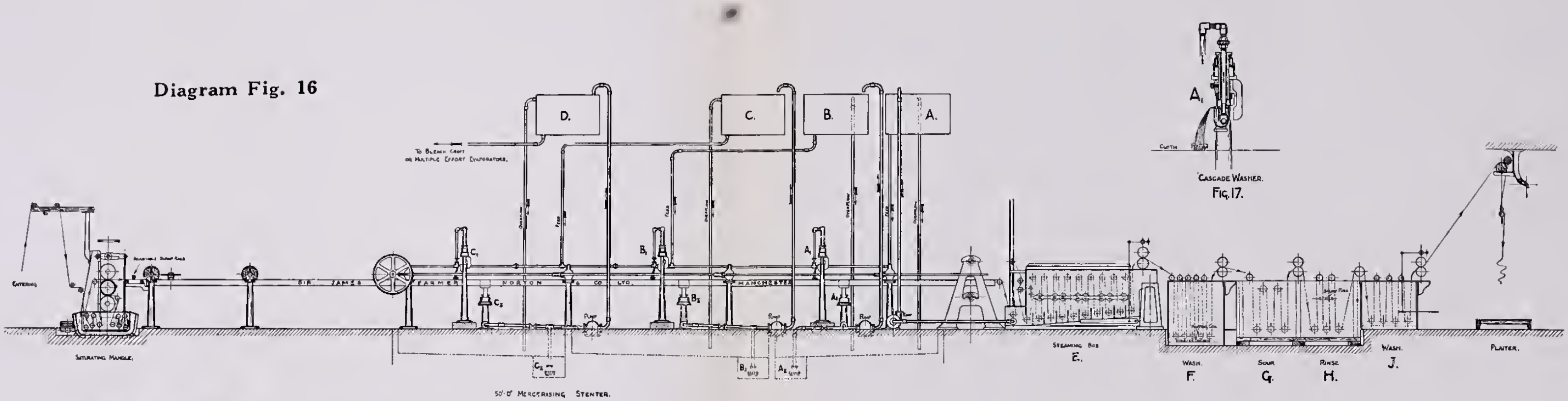
A continuous method of open width bleaching without kier boiling is frequently used, and is preferred by some bleachers as being quicker and more satisfactory for the subsequent dyeing.

The machine, Fig. 15a, consists of a series of tanks placed alongside each other, fitted with guide rollers for carrying the cloth during its passage through the machine. Between No. 4 and No. 5 tank is placed a special Time-Wheel with perforated sides.

The cloth is treated with caustic soda and Tetraline or other degreasing agent, in tanks 1 and 2. In No. 3 it receives a wash in hot water. The cloth is treated with bleaching liquor at 1½ degrees Twaddle in No. 4, and passes into the Time-Wheel in which it remains for 20 minutes. Here the bleaching action takes place. The cloth then passes through a cold wash tank, followed by an acid tank and receives a wash in cold water in the last tank before leaving the machine.

The speed of the machine is from 30 to 60 yards per minute according to the weight of the cloth.

Diagram Fig. 16



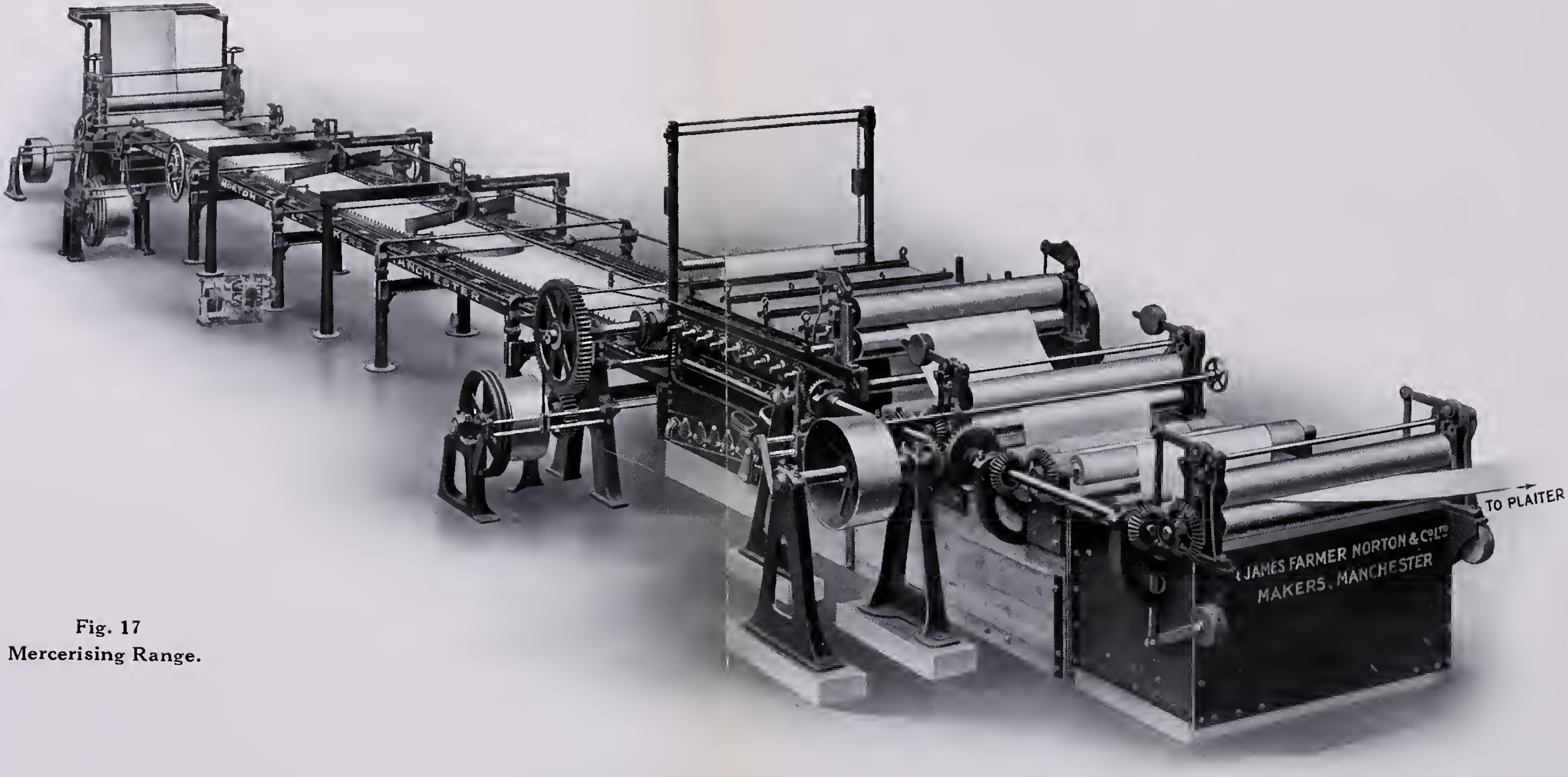


Fig. 17
Mercerising Range.

Mercerisation of Piece Goods.

General Description of Mercerising.

The action of caustic soda, applied under certain conditions to cotton fabrics, produces a silky lustre and gives the material a very beautiful sheen. It is the foundation of many important and beautiful finishes. It also gives the cloth a greater affinity for colouring matters ; deeper and brighter shades are obtained and less dyestuff is used.

Mercerising consists of impregnating the cloth with cold strong caustic soda, stretching the cloth whilst saturated, and washing out the caustic soda while the cloth is still under tension. This treatment produces a permanent change in the structure of the cotton fibre. It is important that the strong caustic soda should remain in the cloth for sufficient time to complete its action on the fibre.

The Farmer-Norton Mercerising Range.

Impregnating Mangle.

Diagram Fig. 16 and Illustration Fig. 17 show a modern Farmer-Norton Mercerising Range. This consists of an Impregnating Mangle of heavy design and compound levered, with two iron bowls and one middle rubber-covered bowl. The bowls are geared together to prevent slipping. The cloth is run into the iron caustic soda tank underneath the Impregnating Mangle, passes over a series of rollers in the tank and between the two lower bowls, where it is squeezed. It is led back into the tank over more rollers and passes through the two top bowls of the mangle, which give it a final squeeze.

Stenter. On leaving the mangle, the cloth enters the stretching Stenter where it is held under tension. It is gripped on the selvedge by two horizontal endless chains of automatic clips. To prevent corrosion by the caustic soda the clips are made of malleable iron fitted with nickel plates and jaws. The chains slide on rails which are adjustable in width. The first section of the Stenter rails is tapered so as to apply the tension gradually to the cloth, and the remaining sections are nearly parallel and hold the cloth at full tension.

Suction Boxes and Pumps. Whilst passing over the Stenter the cloth is sprayed with a solution of caustic soda and water. Underneath the Stenter are special troughs with perforated lids close to the underside of the cloth. These are called suction boxes and are connected with pumps, which suck the caustic soda which has been sprayed on to the cloth, through the cloth and away to tanks. The suction boxes are made adjustable to suit the width of the cloth.

Recovery of the Caustic Soda. Caustic soda has a high commercial value and it is therefore important that as much as possible should be recovered and at as high a degree of concentration as possible. In order to do this, a special system of washing (which is explained later) is adopted on the Stenter. After leaving the Stenter, the cloth passes over compensating rollers (which regulate the tension), into and through a steaming box divided into a series of compartments. In each compartment the cloth is treated with steam, the action of which dissolves the residue of the caustic soda in the cloth. This residue is pumped into a collecting tank " A " placed near the roof of the

Steaming Chamber.

“Cascade” Washing Troughs.

Collection and Concentration of the Caustic Soda.

Mercerising Room, see diagram No. 16. The caustic residue falls by gravity from this tank to a special washing trough “ A_1,” which is called a “Cascade” Washer, Fig. 17. The trough covers the full width of the machine and is adjustable to suit various widths of cloth. The liquor flows over the lip of the trough in a cascade, which pours on the cloth over the full width. The “Cascade” Washer is an improvement on the old-fashioned method of perforated spray pipes. It was found that the holes in these pipes constantly became choked and as a result the cloth was unevenly washed, and the faulty washing caused marks in the subsequent dyeing. The liquor from the “Cascade” Washing Trough is partly sucked away by the suction boxes and part falls into the pit underneath the machine. It is pumped from the suction box “ A_3 ” and pit “ A_2 ” to another collecting tank “ B.” From here the operation of cascade washing and suction box is repeated. Usually there are two or three suction boxes fitted underneath the Stenter. The caustic from the last suction box “ C_3 ” and pit “ C_2 ” is pumped to the final collecting tank “ D.” It will be seen that by this method the caustic soda collected in the final tank “D” is at the highest state of concentration possible. The caustic soda in tank “D” can be utilised in the Bleach-croft for the Kiers or sent to the Multiple Effort Evaporators, where it is brought back to its original mercerising strength and used again in the Impregnating Mangles.

Treatment of the Cloth after Steaming.

On leaving the steaming box “ E,” the cloth is squeezed by a rubber and iron nip. It is then passed through the washing tank “ F,” and enters the souring tank " G," where it is treated with dilute acid to neutralise any traces of caustic soda. It then passes to tank " H," where it receives a thorough rinse in clean water by means of a system of spurt pipes. Finally it is washed in tank " J," squeezed and plaited down.

Mercerising Heavy Cloth. For mercerising some classes of heavy goods it is necessary to employ two Impregnating Mangles in order to get adequate impregnation. Between the two mangles are placed a series of iron drums, whose object is to prevent the cloth shrinking between the two mangles. Illustration Fig. 18 shows a range with this arrangement of two mangles and drums.

Treatment of Fabrics prior to Mercerisation. Mercerisation may be carried out either when the cloth is in the grey state, or after half bleaching or scouring, or in the completely bleached state. Whichever method is used the mercerising process is, in general, the same.

Unbleached material must be first wetted out to facilitate the penetration of the caustic soda.

Bleached material is usually mercerised dry and thus dilution of the caustic soda is prevented. The dilute alkali liquors obtained as washings from grey mercerised material are more difficult to concentrate and to recausticise satisfactorily, as they contain many impurities extracted from the raw cotton and the size.

It is sometimes advisable to mercerise fabrics of low tensile strength in the grey state, on account of the resulting increase in strength which assists the subsequent manipulation of the material in the rope form.

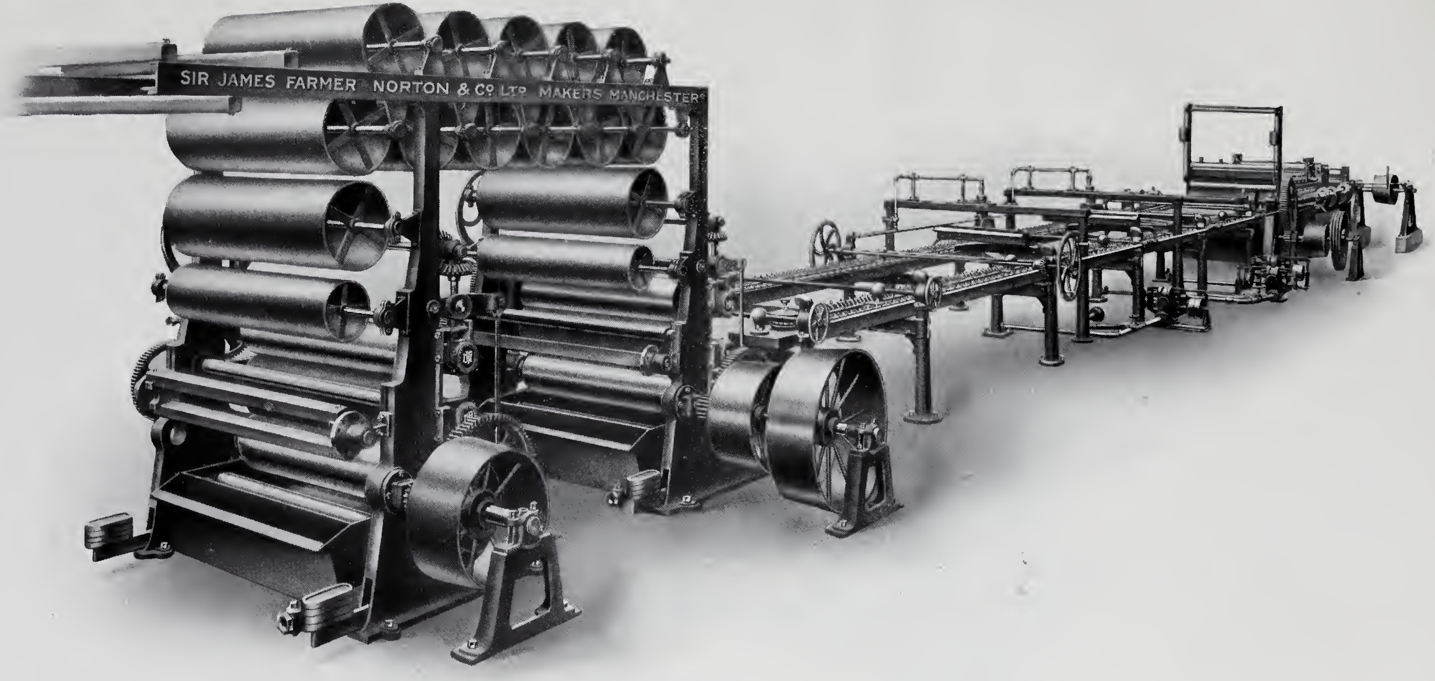


Fig. 18
Mercerising Range with two Impregnating Mangles.

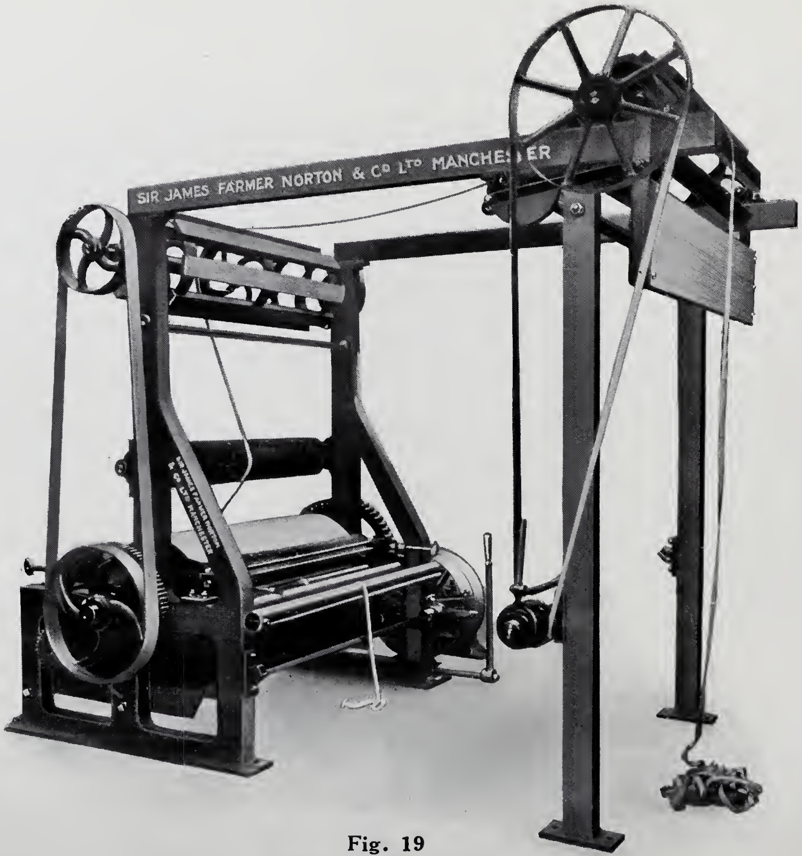


Fig. 19
Back Fill Mangle.

Finishing of White Goods.

After the operations of bleaching, the cloth is either dyed or printed or finished in the white state.

For certain low qualities of material, the object of the finishing is to weight and fill the cloth and thus give it the appearance of a heavier fabric, also to make the goods more suitable for their various purposes.

Back Filling.

Low quality white shirtings and sheetings are frequently back filled, the cloth being starched or filled on the back side only. The filling usually consists of starch, china clay, or other mineral substance, some fatty matters, and antiseptics to prevent mildew. This mixing is prepared and boiled together in a wooden tub fitted with a steam coil. The cloth is filled on the mangle, Fig. 19, which is called in Lancashire a "Tommy Dodd." It consists of framing carrying a large sycamore or cotton bowl, which revolves in a wooden starch box fitted with an agitator, the object of which is to keep the filling thoroughly mixed in the trough. At the entrance a rubber scraper, called a doctor, rests against the bowl, and scrapes and cleans the bowl before the face of the cloth meets it. The cloth passes round the bowl and through the filling. On leaving the trough a brass doctor rests against the back of the cloth and spreads the filling uniformly on the fabric. The cloth is threaded face upwards through the machine, passing first over the tension or stave rails and over a so-called brass scrimp rail (whose object

"Tommy Dodd."

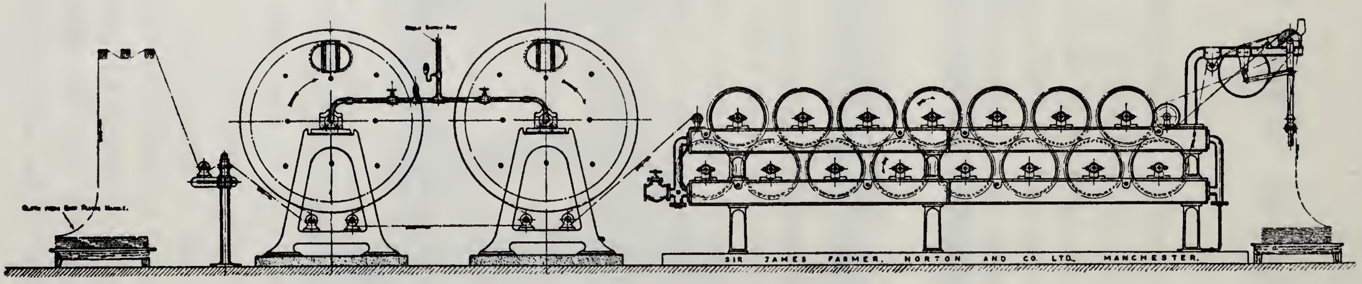


Fig. 20
Drying Range for Back-filled Goods.

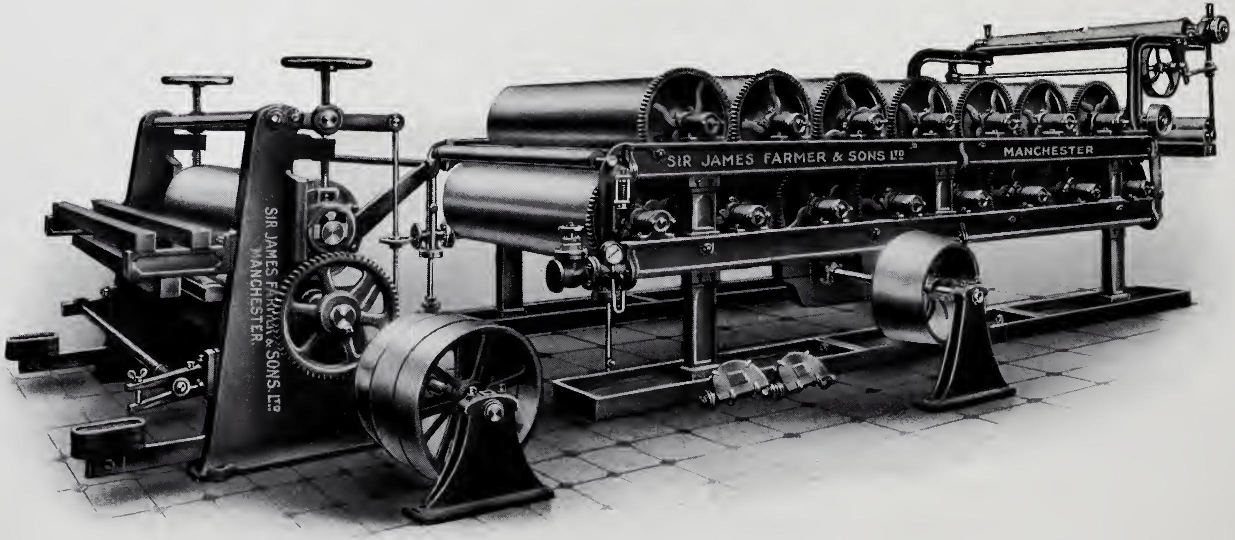


Fig. 21
Starching and Drying Range.

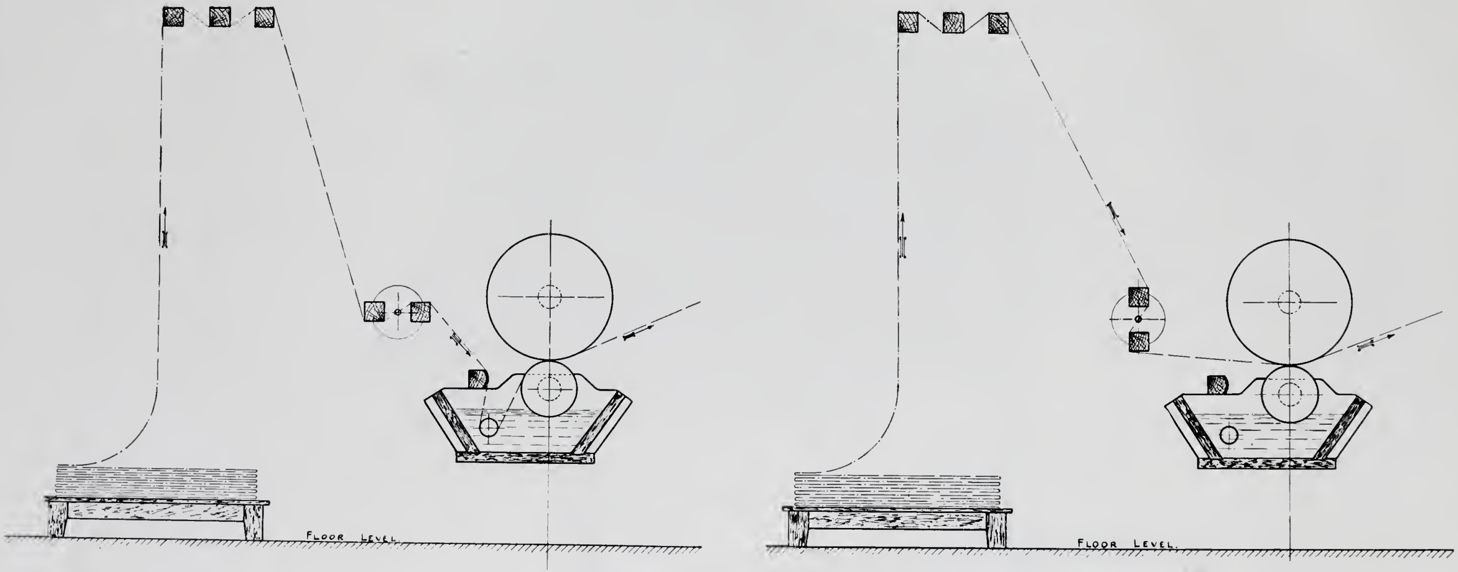


Fig. 21a

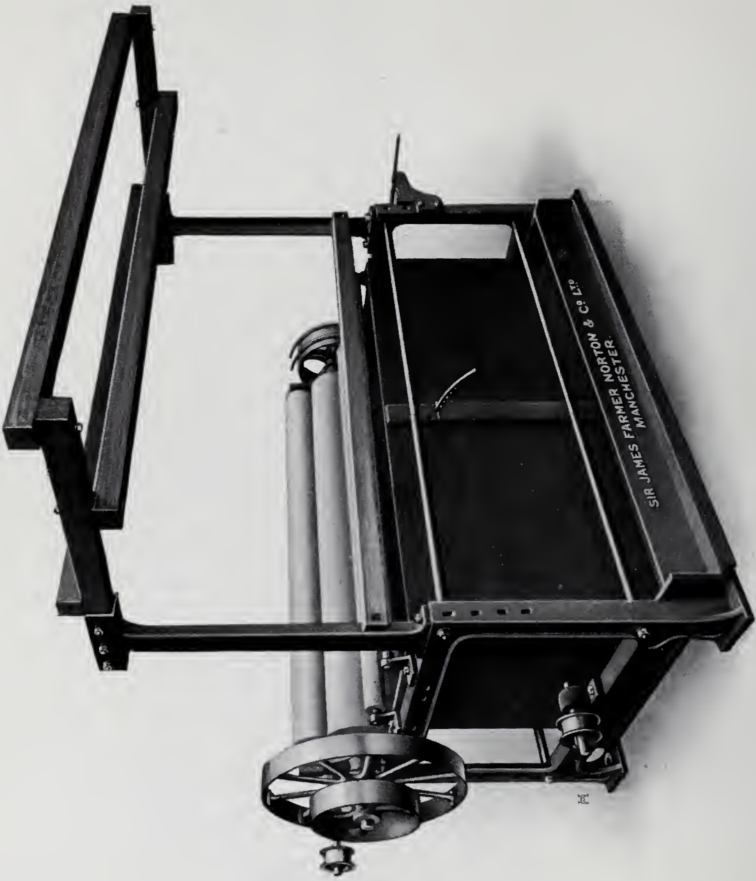


Fig. 22
Brush Damping Machine.

is to remove any creases from the cloth), round the bowl, through the filling, under the brass doctor and thence over the draw winces to the plaiter. It is then dried on a Drying Range, Fig. 20, consisting of one or two 6-ft. copper drying cylinders and an ordinary Horizontal Drying Machine. The cloth is threaded over the large cylinders with its face against the cylinder. The object of this is to partially dry the filling before the back of the cloth comes in contact with the cylinder. This prevents the filling from cracking and peeling off. The goods are then run in the usual way over the Drying Machine and plaited down.

Starching and Drying Range. Other qualities of white goods may be starched and dried on the Starching and Drying Range illustrated on Fig. 21. When a heavy filling is required, the cloth is passed through and immersed in the starch trough under a guide roller before it enters the nip of the mangle, diagram 21a. A light filling is obtained by passing the cloth direct into the nip of the mangle, so that only the lower bowl picks up and deposits the starch. Some better qualities of white goods are starched and dried on the Stentering Range, Fig. 57, page 111.

Conditioning Cloth. After the above-mentioned operations, the cloth is allowed to cool, and it is then conditioned on a Farmer-Norton Brush Damping Machine in preparation for the final calendering. The Damping Machine replaces some of the moisture lost during the drying operation. It is illustrated by Fig. 22, and consists of framing, to which entering stave rails, a pair of wood draw rollers and rolling-up or batching apparatus are fitted. Underneath is a copper, roller, or so-called " brush," covered with copper spikes. This brush is carried in bearings and rests in a wood water-box. The surface of the water is arranged so that the spikes just touch. The height of the water is kept constant and regulated by a special valve. The copper brush is made to revolve at a very high speed, and sends the water in the form of a fine spray or mist between a pair of adjustable shutters on to the cloth. The speed of the cloth on a Damping Machine is about 120 yards per minute.

Belt Stretching Machine.

The batches of cloth from the Damping Machine are allowed to lie for a few hours, and the cloth is then stretched on a Belt Stretching Machine, Fig. 23. This machine consists of a pair of rubber-faced pulleys about 4-ft. diameter, carried on framing and placed at an angle to each other. Round a large part of the periphery of these pulleys endless rubber or canvas belts are led. The cloth passes between the belts and the pulleys and is gripped by the belts. It enters the belts on the narrow side of the pulleys and is led round their periphery and leaves the pulleys on the wide side, and thus receives its stretch. The tension of the belts can be regulated by the jockey pulleys underneath, by hand-screw wheels. The frames carrying the big pulleys are also adjustable so as to give the pulleys more or less angle according to the required stretch. The cloth is batched up against a wood roller and held by cast-iron arms, as shown on the diagram. The speed of a Belt Stretching Machine is about 80 yards per minute.

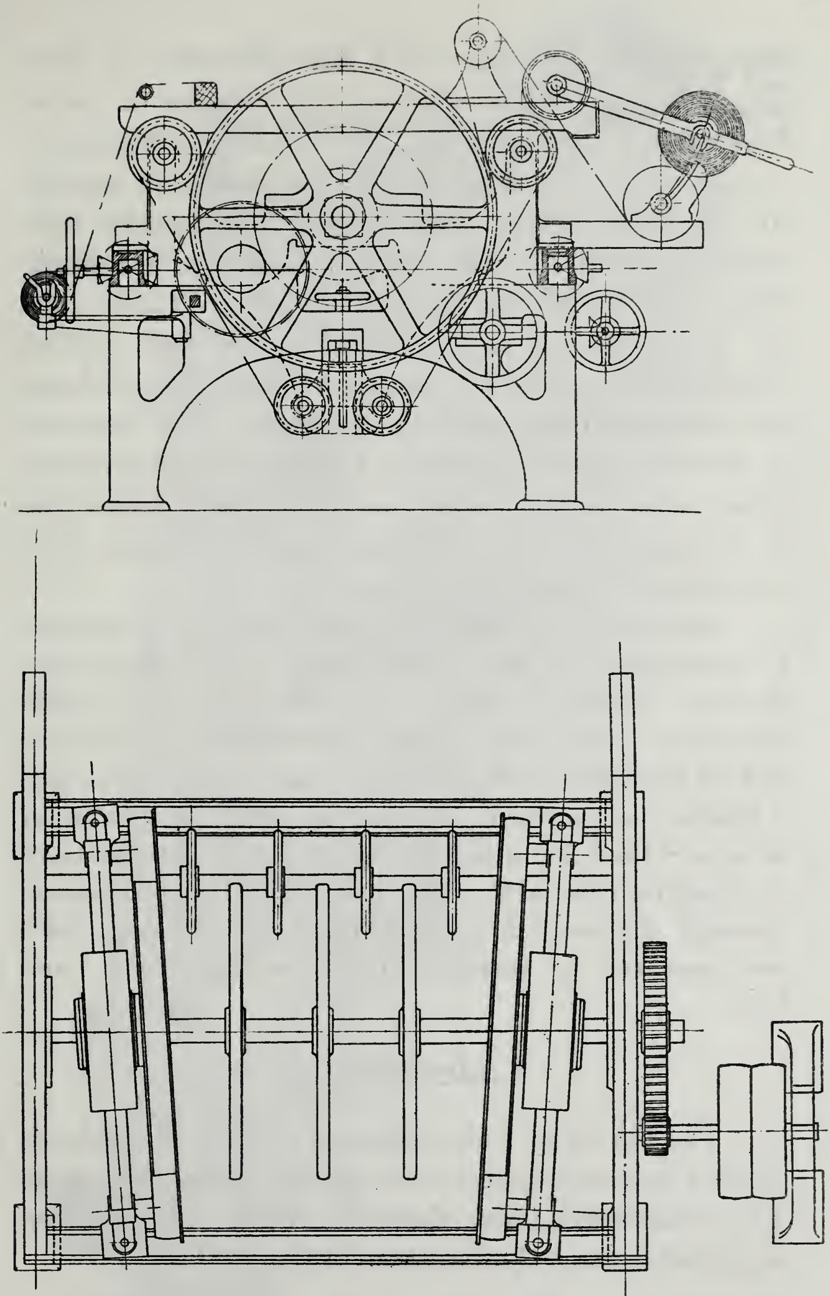


Fig. 23
Belt Stretching Machine.

Short Stenter and Weft Straightening Apparatus. In place of a Belt Stretcher, a short Farmer-Norton Clip Stenter is sometimes used. This machine is illustrated on Fig. 24, and its length is usually 20 or 30-ft. The cloth enters over stave rails and is gripped by two endless chains of automatic clips, which slide on horizontal rails. These rails are adjustable in width. Under the first section of rails is often placed a perforated steam pipe to damp the cloth and thus facilitate stretching. The moisture is removed by heat from a battery of steam-heated gilled pipes under the last section of rails before the cloth leaves the clips. On leaving the clips the cloth is batched up or plaited down.

Stenters are usually supplied with an apparatus to straighten the weft of the cloth, which may have become distorted during the bleaching and other processes. This mechanism is situated at the delivery end on the vertical shaft driving one of the chains, and it enables one of the horizontal clip chains to run faster or slower than the other chain for the period necessary to straighten the weft. The speed variation is obtained through differential gearing from the driving shaft and operated by means of brake pulleys and a hand lever.

Calendering.

The object of Calendering is to close the threads of the fabric and to give it the gloss or " feel " required. The calendered finish depends chiefly on pressure, temperature and the moisture in the cloth.

Calenders. For white goods, Calenders with 3, 5, 6, 7 or 10 bowls may be used according to the output

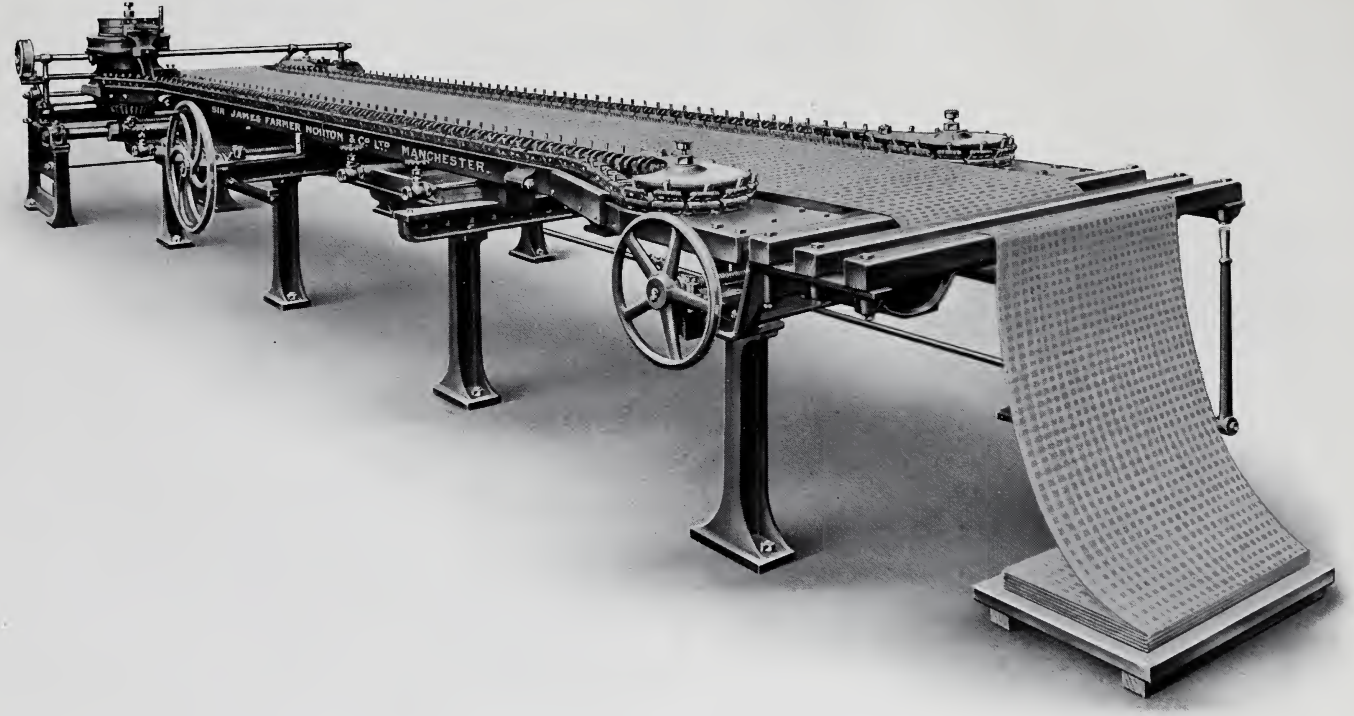


Fig. 24
Short Stenter with Weft Straightening Apparatus.

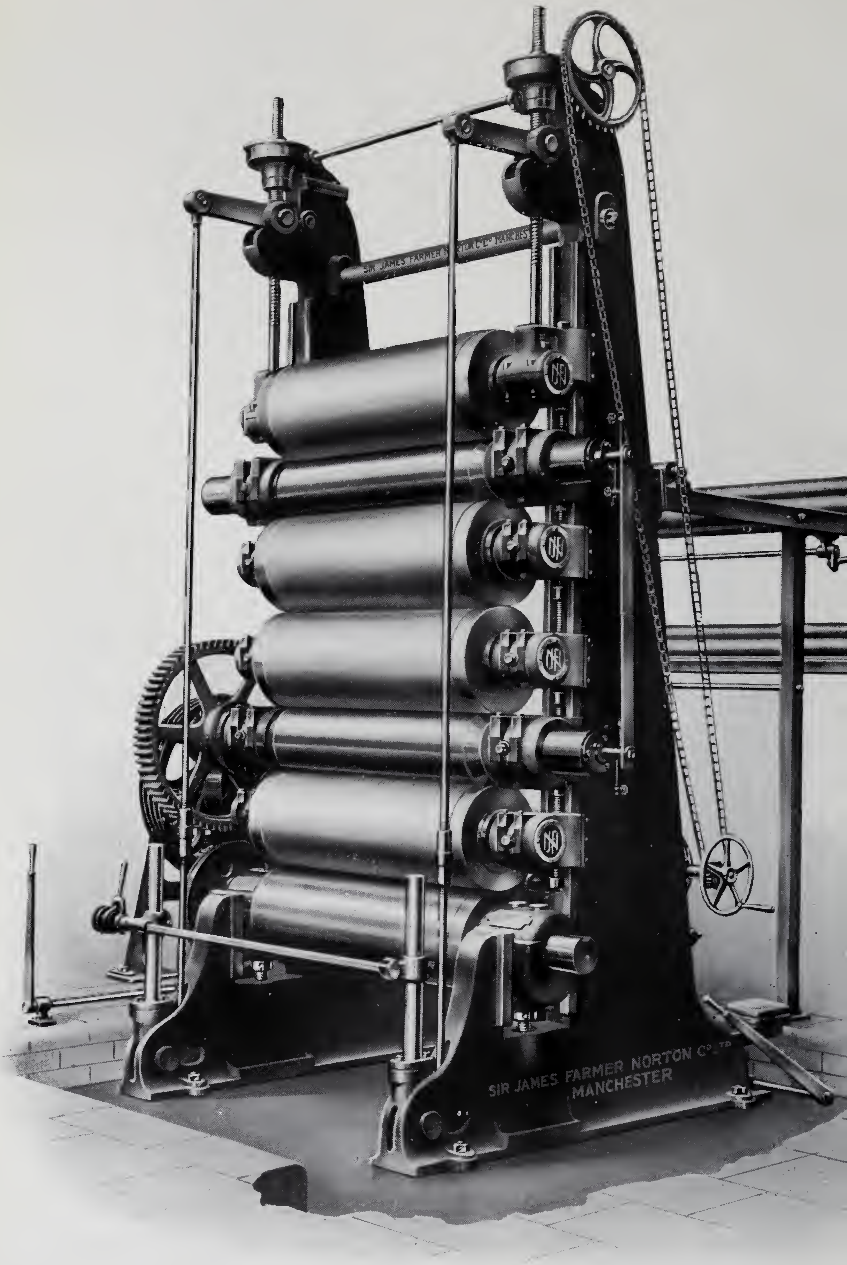

SIR JAMES FARMER NORTON C° L^D MANCHESTER
SIR JAMES FARMER NORTON C° LTD
MANCHESTER

Fig. 25
Seven-bowl Calender.

and type of finish required. Illustration Fig. 25 shows a Farmer-Norton Seven-bowl Calender. The arrangement of bowls in this Calender is usually as follows :—

1. At the bottom, close-grained iron.
2. Compressed cotton.
3. Highly polished chilled-iron, steam-heated.
4. Compressed cotton.
5. Compressed cotton.
6. Highly polished chilled-iron, steam-heated.
7. Compressed cotton.

The Farmer-Norton Calender is built with very massive frames and strong compound levers, so that heavy pressure can be used. The bearings of the bowls are of the ring-oiling type and are so constructed that any bowl can be easily removed from the Calender. The drive of the Calender is either by engine, electric motor, or friction clutch and pulley.

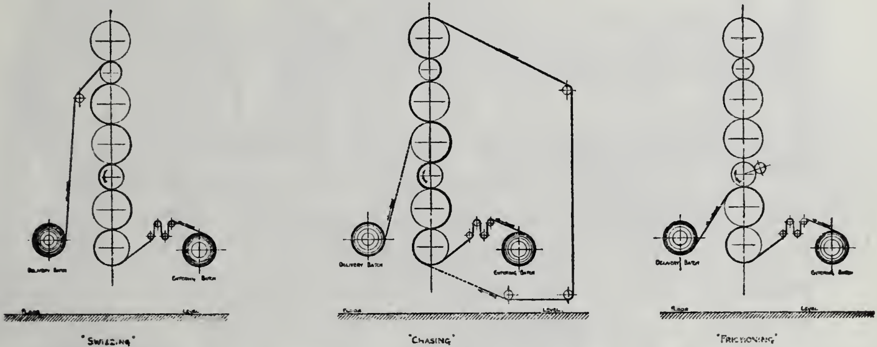


Fig. 26
Methods of threading the cloth for "Swizzing," "Chasing," and "Friction" Finishes.

Calenders containing more than three bowls are usually constructed so that three types of finishing, viz., Swizzing, Chasing or Frictioning can be done on them, and when so designed are called Universal Calenders. The methods of threading the cloth through the Calender for the various finishes are shown on the Diagram Fig. 26.

Swizzing and Chasing Finishes. By "Swizzing" is meant simply running the cloth through the nips and plaiting down or batching. "Swizzing" closes the interstices of the cloth and smooths its appearance. Ten-bowl Calenders are occasionally used for swizzing finishes, Fig. 30. They are principally employed where a very large output is required.

To obtain the "Chasing" finish, the cloth passes through the nips of the Calender, over chasing rollers and into the bottom nip of the Calender again. It is led through in this manner several times, each layer of cloth lying over another. The effect of "Chasing" is to give to the cloth a thready-linen appearance and a special soft "handle" or "feel."

Imitation Beetle Finish. Fig. 29 shows a Farmer-Norton Six-bowl Calender, with a bottom iron bowl, and the remainder cotton bowls. It is used for Swizzing and Chasing finishes and to give an imitation Beetle finish. It gives a thready and linen-like effect to the cloth.

Friction Finish. When the cloth requires a high glaze on one side and also to be heavily closed, friction is employed. For this finish, the three lower bowls of the Calender only are used. The third polished chilled-iron bowl, which is heated with steam, is made, by an arrangement of gear wheels, to revolve at about double the speed of the cloth and of the two lower bowls. If there are other bowls above No. 3 they are lifted out of contact with No. 3, see Fig. 26. The cloth passing between No. 2, which is revolving at the slow speed, and No. 3 at the high speed, receives a high polish on its face by the rubbing action of No. 3. Fig. 27 shows a Farmer-Norton Three-bowl Friction Calender of the heavy type. Fig. 28 a Farmer-Norton Five-bowl Universal Calender.

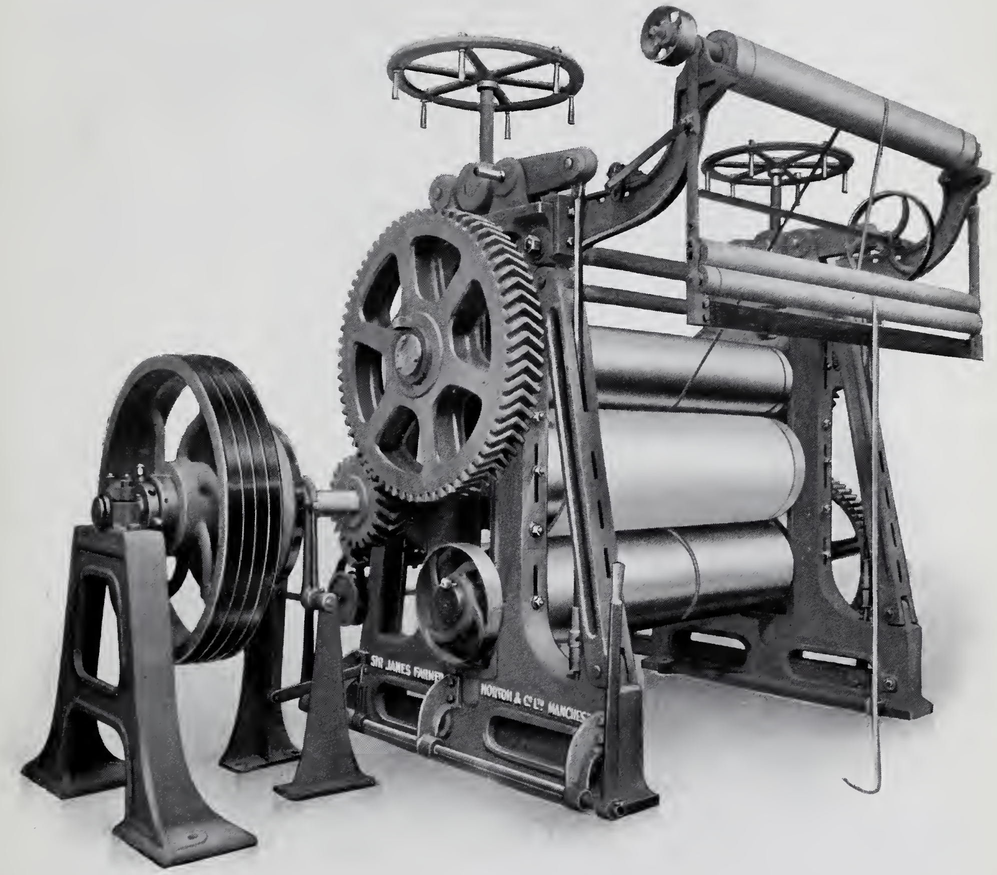


Fig. 27
Three-bowl Heavy Friction Calender.

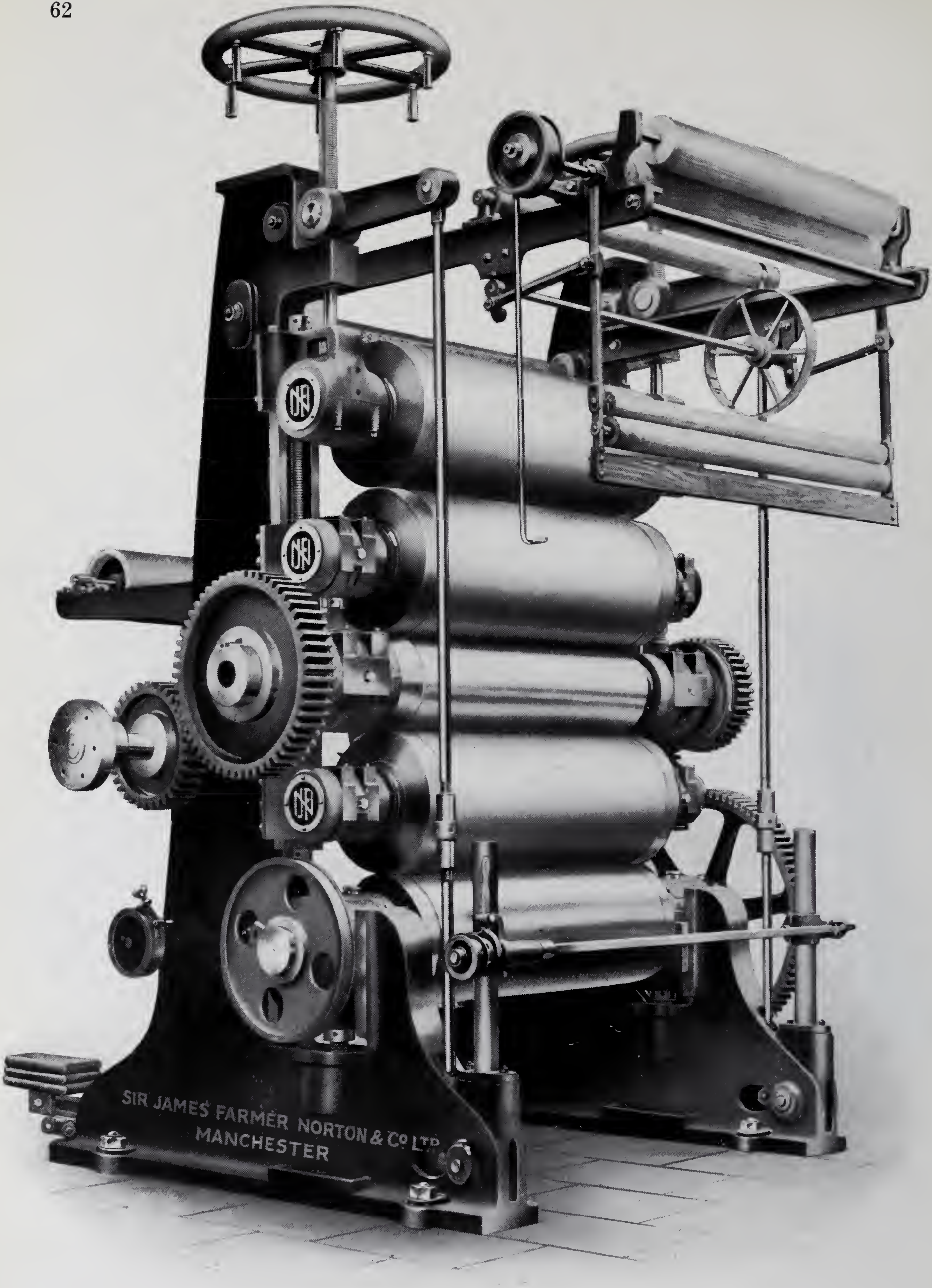


Fig. 28
Five-bowl Universal Calender.

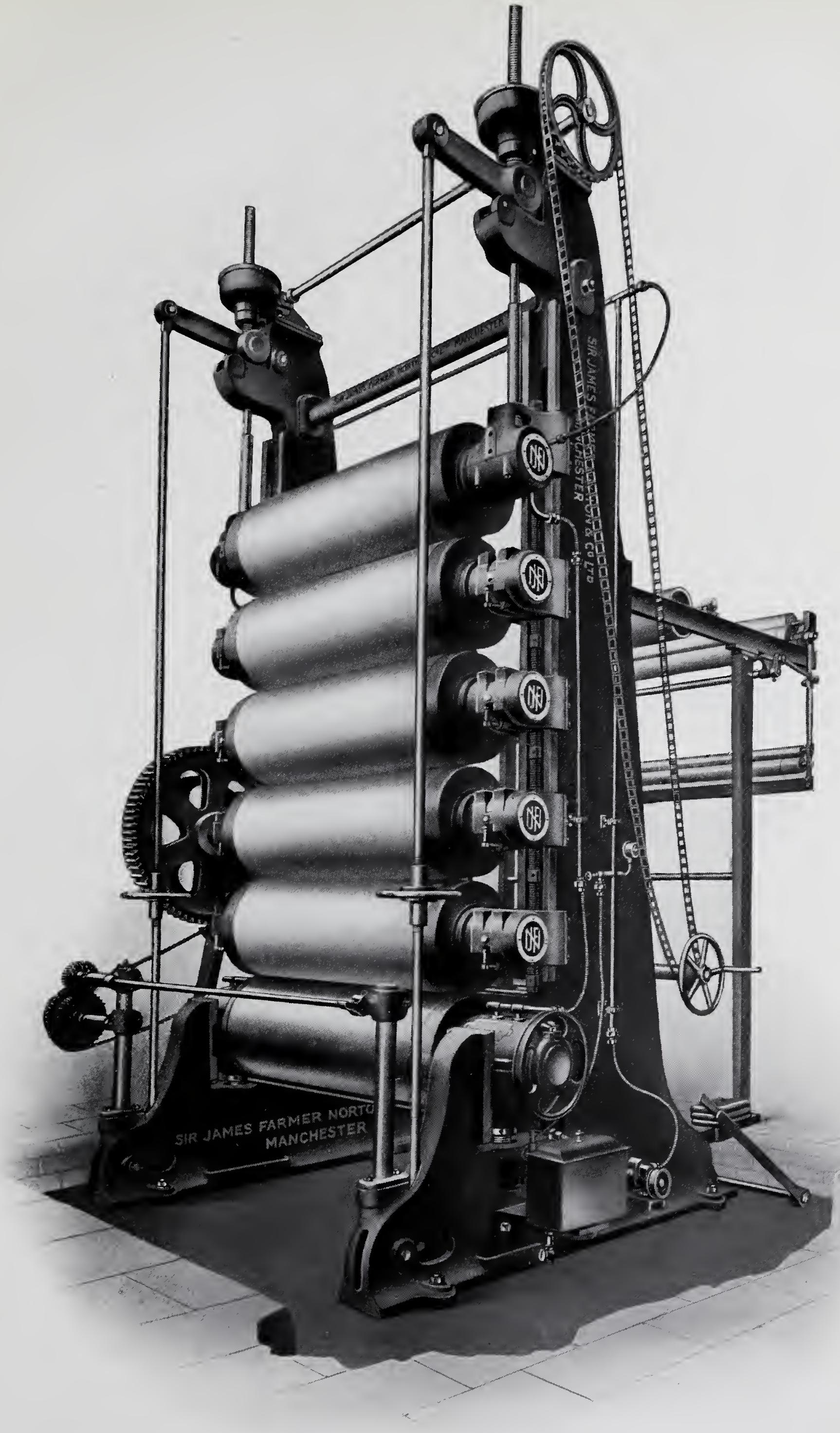


Fig. 29
Six-bowl Calender for Imitation Beetle Finish.

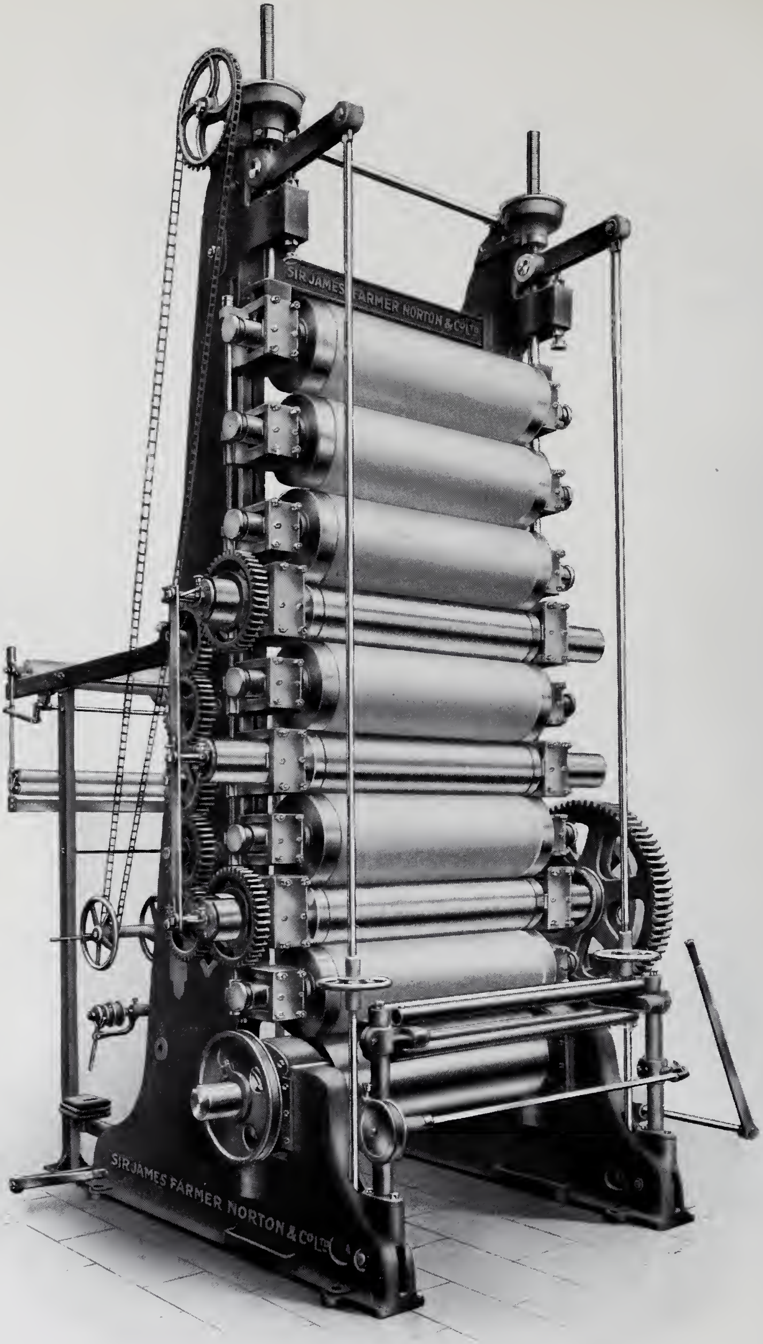

SIR JAMES FARMER NORTON & Co LTD
SIR JAMES FARMER NORTON & Co LTD

Fig. 30
Ten-bowl Swizzing Calender.

Calender Speeds. The speed of a Friction Calender is about 35 yards per minute. The speed of the cloth on a Three-bowl Calender working without friction is about 60 yards ; on a Five-bowl Calender, 70 yards ; and on a Seven-bowl Calender, 90 yards per minute.

The speed of a Calender when used without Friction is regulated by the amount of finish it is desired to produce on the cloth, and the number of bowls used. Where little finish is required, higher speeds than those mentioned above may be obtained. In some Bleach Works the Seven-bowl Calenders are worked at speeds of 150 to 250 yards per minute. When using Friction, the speed of the cloth is independent of the number of bowls, as the three bottom bowls only are operated.

After calendering, which completes the treatment of white cloth, it is taken to the Making-up Department.

Dyeing of Cotton Piece Goods.

There are many dyeing processes used on cotton, varying according to the class of dye used and the effect it is desired to obtain. It is proposed to consider only a few standard processes of dyeing for certain classes of colours which are in general use.

Direct Dyes.

Dye Jigger.

These are dyestuffs applied direct on to the cloth, usually in a Dye Jigger, Fig. 31. The dye solution, consisting of the dye liquor together with the usual additions of common salt, soda ash, etc., is placed in the trough of the Jigger, which is made either of cast iron or wood with iron ends, and is provided with a steam pipe. In the bottom of the trough are two guide rollers, which are immersed in the dye liquor. At the top of the trough also are two guide rollers. The cloth, which has usually been previously "wetted out," is run from the batch arms over the batching roller, over the guide roller at the top of the trough, through the liquor and under the bottom guide rollers, and is batched up on the top batching roller at the other end. This operation is then reversed and the cloth runs backwards and forwards through the liquor until the required shade is obtained. The Dye Jiggers are usually placed in a row and driven by a horizontal shaft. They are so arranged that each Jigger can be worked independently by means of clutches, Fig. 31.

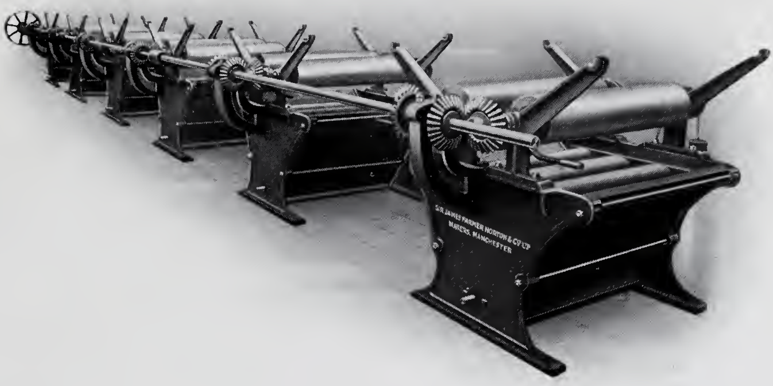


Fig. 31
Dye Jiggers.

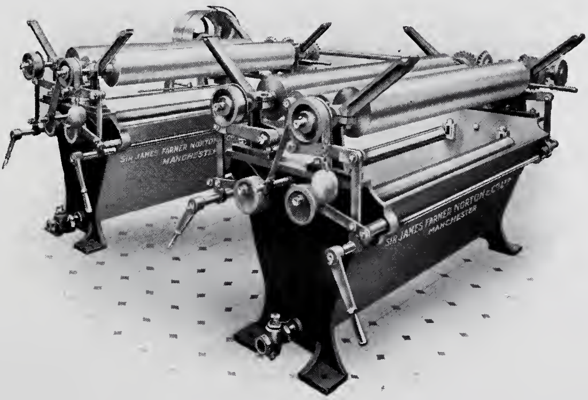


Fig. 32
Dye Jiggers for Sulphur Colours.

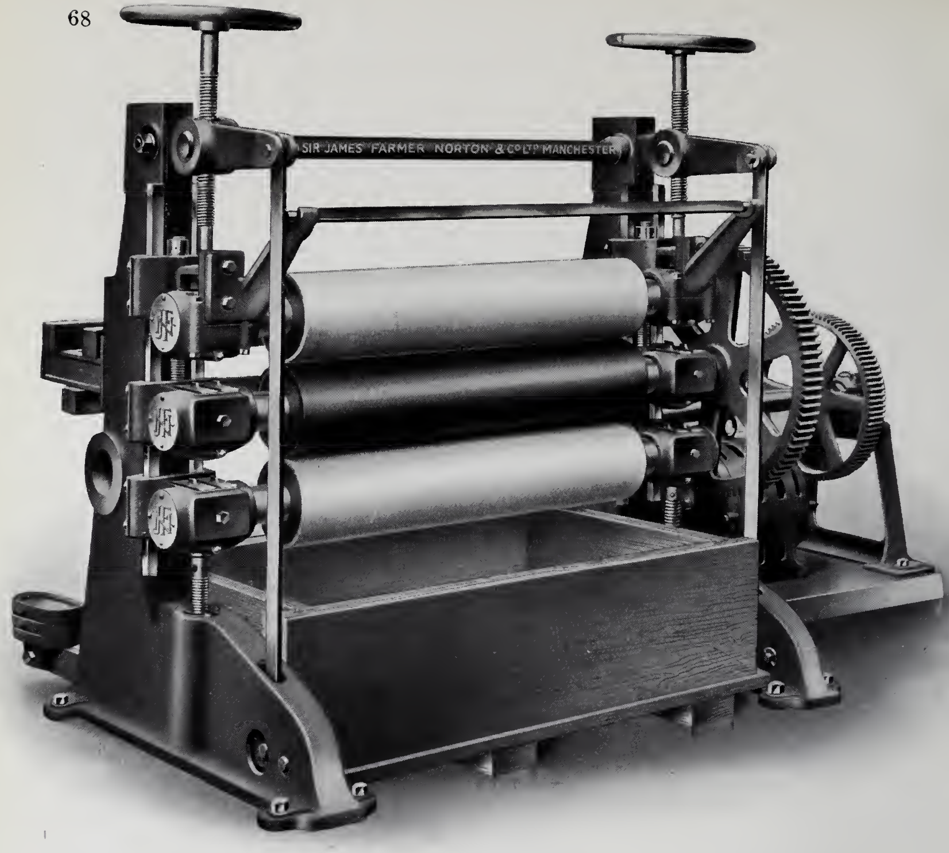


Fig. 33
Dye-house Mangle.

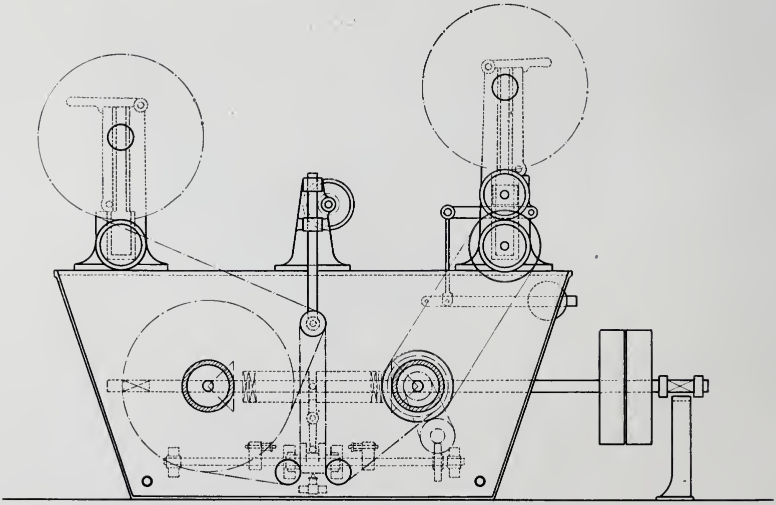


Fig. 34
Farmer-Norton Under Liquor Dye Jigger, with automatic reversing arrangement, for Vat Colours.

Dye-House Mangle. After dyeing, the goods are rinsed and squeezed on a Dye-house Mangle, Fig. 33, and afterwards dried on a Drying machine of the horizontal or vertical type, Fig. 10 or Fig. 10a.

Sulphur Dyes.

Sulphur Jigger. The machinery used in this class of dyes is similar to that used for direct dyes, with the exception that the Jigger used is provided with horizontal compound levered squeezing rollers, Fig. 32. The object of these squeezing rollers is to facilitate the penetration of the liquor.

Vat Dyes.

Certain colours, including some of the so-called vat colours, are dyed on special Padding Machines, with the object of economising the use of the dye liquor and ensuring even dyeing.

Under Liquor Jigger. In order to prevent uneven oxidisation, a special Jigger in which the cloth remains immersed in the liquor through the dyeing operation, is specially recommended for vat colours, and is illustrated by Fig. 34.

Aniline Blacks.

The Copper Black Process and the Steam Black Process are the cheapest and most economical methods of dyeing aniline blacks.

Copper Black Process. In the copper black process copper sulphate is used as an oxidising agent. The Farmer-Norton range of plant for this purpose is illustrated by Fig. 35.

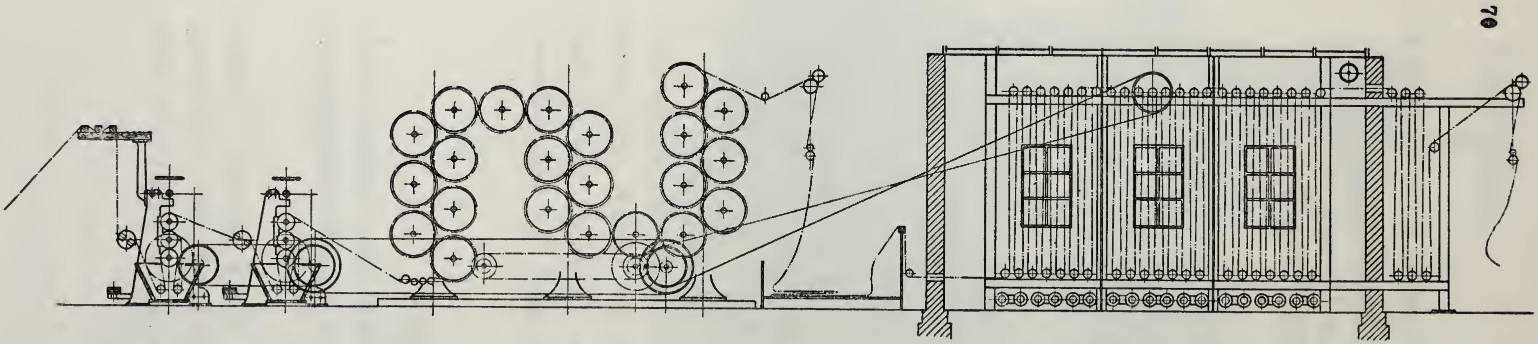


Fig. 35

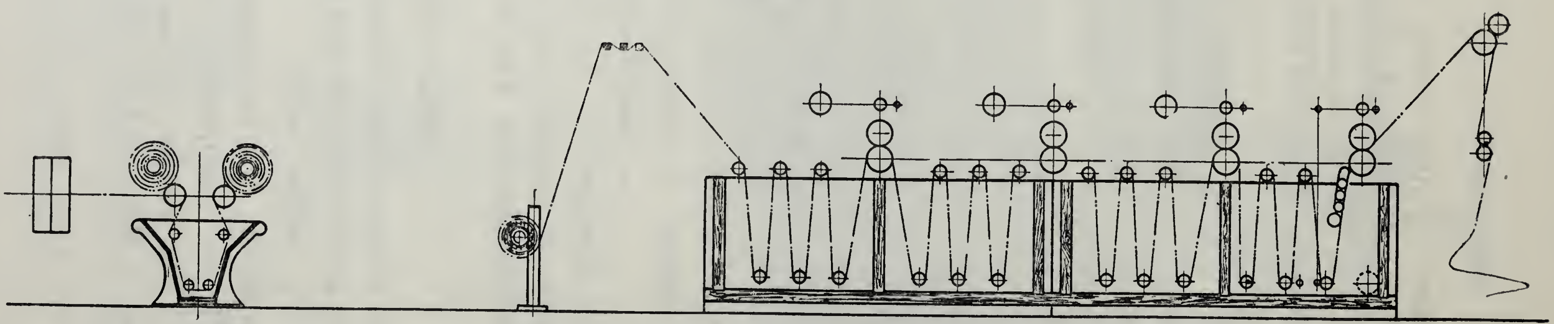


Fig. 35a
Copper Black Dyeing Range.

Padding. It consists of two Padding Mangles, each with two rubber bowls and centre vulcanite bowl. The dye liquor is a solution of aniline oil, chlorate of soda, copper sulphate and hydrochloric acid. It is padded on to the cloth in the troughs of the two mangles. Each mangle is provided with compound levers to give a heavy squeeze and thus ensure good penetration. **Drying.** The cloth, after leaving the mangles, passes on to the Farmer-Norton Vertical Drying Machine, which is usually arranged in three stacks. Each stack of drying cylinders has a separate regulating valve, so that the temperature of the cylinders can be varied. On leaving the Drying Machine, the cloth, which has acquired a dark green shade, is plaited down and enters the Ager (marked "F" on the diagram), where the black is developed. This is a chamber usually of brick. **Ageing.** Inside is an iron framework carrying a series of driven guide rollers. At the bottom of the chamber are rows of gilled heating pipes and a perforated steam pipe with a valve. The cloth passes over the series of guide rollers, and after leaving the chamber at the opposite end, is led over further guide rollers provided for cooling it, and it is then plaited down. Ventilation is obtained by means of a fan.

Fixing. The black is fixed on the cloth by passing it through bichromate of soda in Dye Jiggers, Fig. 35a. **Washing.** It is then thoroughly washed in a Four-tank Farmer-Norton Open Washing Machine, Fig. 35a, and dried on a Drying Machine ready for finishing. Copper Black may be produced by this plant at about 25 yards per minute, but where larger outputs are required the arrangement of the plant will vary accordingly.

Prussiate or Steam Black. This black is dyed by machines similar to those described for copper black. The copper salts are replaced by prussiate of potash and chlorate of soda.

Steaming Ager. The ageing of prussiate black is usually done in a short Steam Ager, Fig. 48 (described on page 94), where it is treated with wet steam. The standard Ager has a capacity of 150 yards, and can develop the prussiate black at about 60 yards per minute.

The Ager previously described for copper blacks is often so arranged that prussiate blacks can also be developed in it. Owing to the chemicals used, steam black is a more expensive process, but it is not so liable to make the cloth tender.

Steam Black Resist Printing. Steam black for resist printing is usually padded and dried on the Hot Flue illustrated on page 73. After printing with the resist, the black is developed in the Steam Ager, Fig. 48.

Paranitraniline Red.

This type of red is very popular and is a bright and fast colour.

Padding. The cloth may be impregnated on a Farmer-Norton Three-bowl Padding Machine, consisting of two rubber bowls and one vulcanite bowl, Fig. 36. The trough of the padding machine is kept filled with the Beta-naphthol solution.

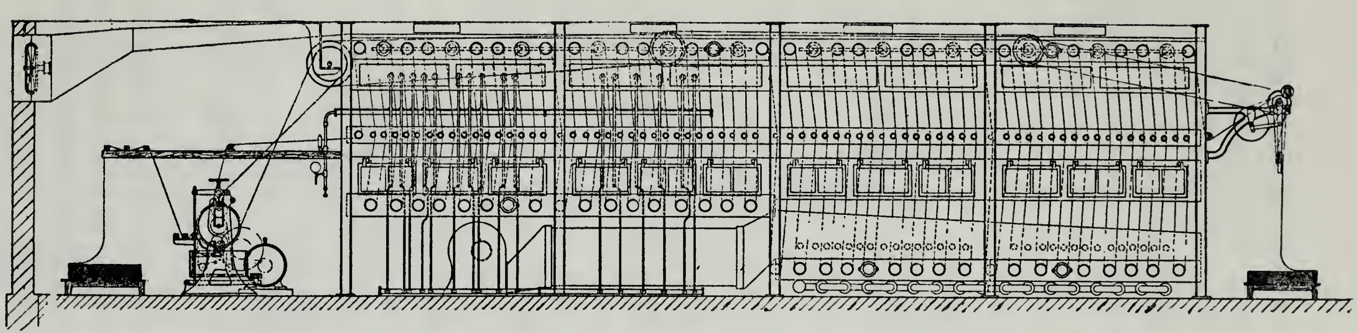


Fig. 36
Padding Mangle and Hot Flue.

Drying on Hot Flue. On leaving the Padding Machine, the cloth passes to the Hot Flue, where it is dried by the action of hot air blown on to the cloth from a multitubular heater by a fan. The cloth passes through the chamber, consisting of sheet-iron walls covered with non-conducting material, over two rows of copper guide rollers, of which a large number in the top row are driven, and it leaves the machine at the opposite end by means of a plaiter. The air is blown in between the folds of the cloth at the bottom of the machine and is drawn out at the top by an exhaust fan.

Sometimes in the first and second compartments of the Hot Flue a series of steam-heated steel chests or plates are placed between the folds of the cloth.

Hot air is distributed through channels which run along each side of the chamber, connected by cross pipes between which the folds of the cloth pass. In these cross pipes there are slots from which the hot air issues. The length of the slot can be varied according to the width of the cloth being dried.

Hinged windows are provided on the sides for ready inspection and access. The requisite capacity of the Hot Flue is determined by the quantity of cloth to be produced in a given time. The machine shown in Fig. 36 has a capacity of 250 yards per minute and will run at about 60 yards per minute on ordinary calico.

The drying, after padding, may also be done on an ordinary Cylinder Drying Machine, though more skill is required to obtain good results by this method than by using the Hot Flue, as the cloth is apt to dry too rapidly on the cylinders.

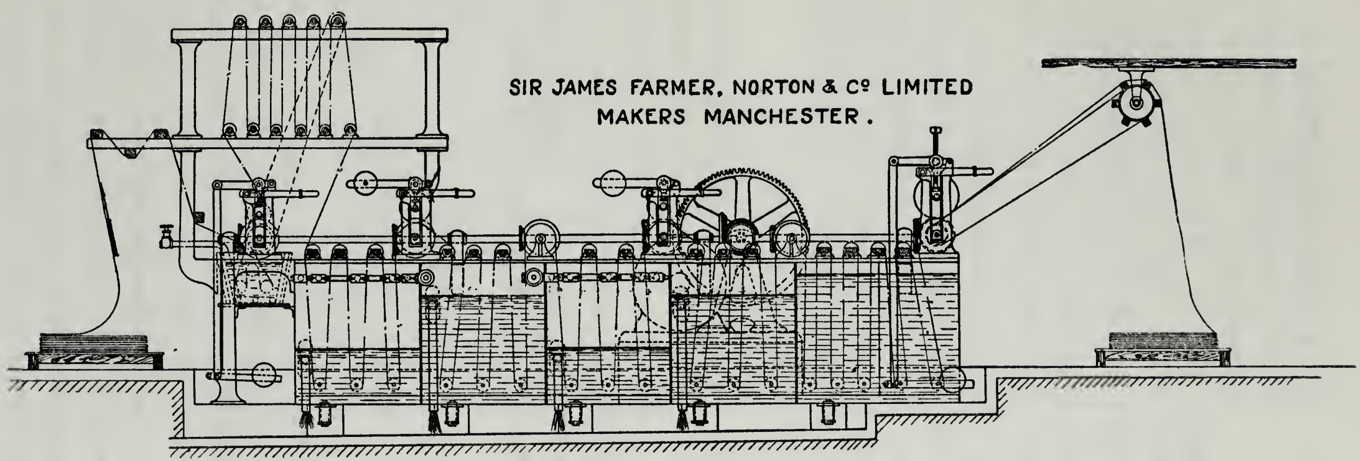


Fig. 37
Developing Range for Para Red.

Development of the Colour. The padded cloth should be developed as soon as possible after drying. The developing is done on a Two-bowl Padding Mangle, Fig. 37. The trough underneath the mangle is kept filled with the developing liquor of diazotised paranitraniline, the temperature of which should be kept cold and not exceed ten degrees centigrade, otherwise decomposition of the liquor takes place.

The cloth is passed through the trough, under the rollers immersed in the liquor, and is squeezed between the two bowls. It is then passed through the air over a roller framework for several yards to give the dye time to develop. Afterwards it is washed on the Five-tank Washing Machine and then dried.

Naphthol A.S. Series of Colours. The reds of this series are faster than Para Red and do not require to be dried between the padding in the Naphthol and the developing. The two processes are done continuously and for this reason Naphthol A.S. Red is in some cases replacing Para Red.

Indigo.

"White Indigo." Indigo, being insoluble in water, must be reduced to "white indigo," by any of the well-known reducing agents such as hydrosulphite, lime copperas, etc. The resulting solution is capable of being absorbed by cotton. It has a greenish yellow colour and is known as "white indigo." After the goods have been impregnated with "white indigo," they are allowed to run through the atmosphere where they absorb oxygen, with the result that the reduced indigo is re-oxidised to the insoluble indigo blue.

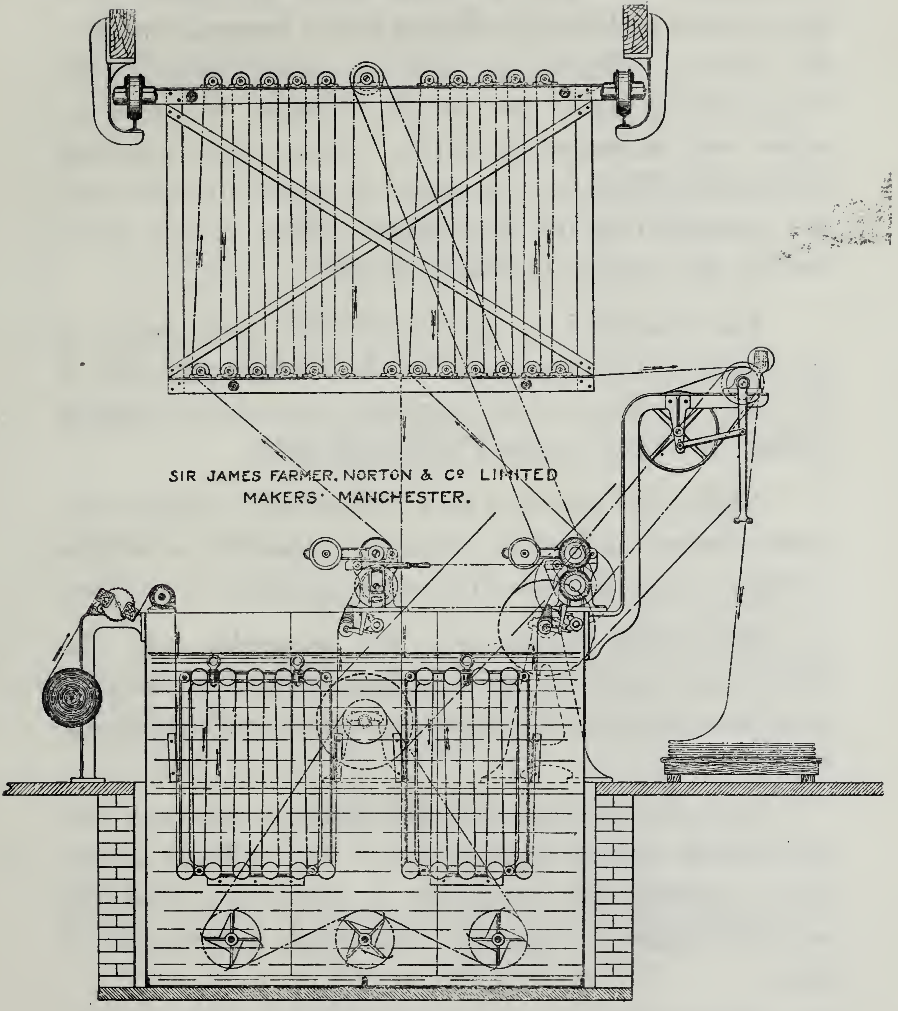


Fig. 38
Indigo Dyeing Machine.

Dyeing Machine. The machine for dyeing cotton piece goods with indigo is shown on Fig. 38. It consists of an iron vat furnished with agitators in the bottom to bring the liquor into a proper condition for dyeing. Before the cloth is passed through the vats, the agitators are usually stopped in order to allow any sediment to settle. Iron cages, carrying the guide rollers for the cloth, fit inside the vats and are immersed in the dye liquor. They can be lifted out of the vats to facilitate cleaning.

The machine is provided with two pairs of squeezing rollers, one pair in the middle and one at the end. In front of the squeezers are conical opening rollers to remove creases from the cloth.

Above the machine is a framework, to carry the cloth during oxidisation, which is suspended on wheels so that it can be moved from one machine to another.

The cloth passes over the expander into the dye liquor, over the guide rollers carried in the first iron frame, through the squeezer and on to the oxidising frame.

It is then led back into the liquor in the tank and through the second squeezer on to the oxidising frame. This sequence of operations is continued until the required shade is obtained. The cloth is then plaited down.

Usually there are several of these dyeing tanks with oxidising frames suspended on wheels between each pair.

After dyeing, the goods are rinsed in water and dried.

Some Tests for Dyes on Cotton.

Test No.	Treatment.	Result.	Inference.
1	Boil in test tube with very dilute NH_4OH or soda	Considerable bleeding.	Direct Cotton Colour (DCC).
		None.	DCC (diazotised and developed) sulphur, mordant (logwood black), azoic colours, aniline black and vat colours.
		Slight bleeding.	Basic Colour.
2	Boil with 5 per cent. caustic soda	Colour destroyed.	Basic Colour. This is characteristic.
		Violet solution.	Turkey Red.
3	Boil with Hydro-sulphite solution.	Colour destroyed.	DCC. diaz. and developed. Most azoic colours.
		Colour destroyed but restored in air.	Sulphur and most vat colours. Colour destroyed and restored only by persulphate or peroxide = basic.
		None.	Aniline and logwood blacks; many mordant colours, turkey red, etc.
4	Boil with 5 per cent. HCL ..	Reddish liquid.	Logwood black. This is characteristic.
5	Treat with hot bleaching liquor.	Colour destroyed.	Basic, DCC, sulphur and logwood.
		Little or no effect.	Aniline black and vat colours. Some azoic colours, some mordant colours.
6	Boil with Zn and HCL in test tube	Paper moistened by solution of lead acetate turns black with H_2S given off.	Sulphur colours only and hydron blue (vat colour).
7	Treat with $KMnO_4$ solution and then with bi-sulphite and acid	Brown colour.	Aniline blacks, which are fast to all other tests. Almost all other colours are bleached white by this.
8	Hot chloroform	Colour extracted.	Azoic colours (para red, etc.), Indigoid vat dyes.

Basic Colours.

Basic dye topped upon direct cotton colour—

Boiling alcohol plus acetic acid strips off most of the basic colour. If water is added, the solution will then dye tannin mordanted cotton or acetyl silk. No other colours used on cotton will dye acetyl silk.

Aniline Black.

Aniline Black is distinguished by its fastness to boiling soap, acid, alkali or hydrosulphite. Distinguished from sulphur black by boiling with bleaching powder solution about 4° Twaddle. Sulphur black is quickly bleached. Aniline Black changes very slowly and then only to a brown. Also boiling hydrosulphite solution has no effect on Aniline Black (Test No. 3). Apply also Test No. 7.

Turkey Red.

Boiling NaoH gives violet extract which gives yellow with acid. Boiling 5% HCL gives yellow solution which becomes violet with NaoH. Also hot chloroform gives no extract (Test No. 8) distinction from para red.

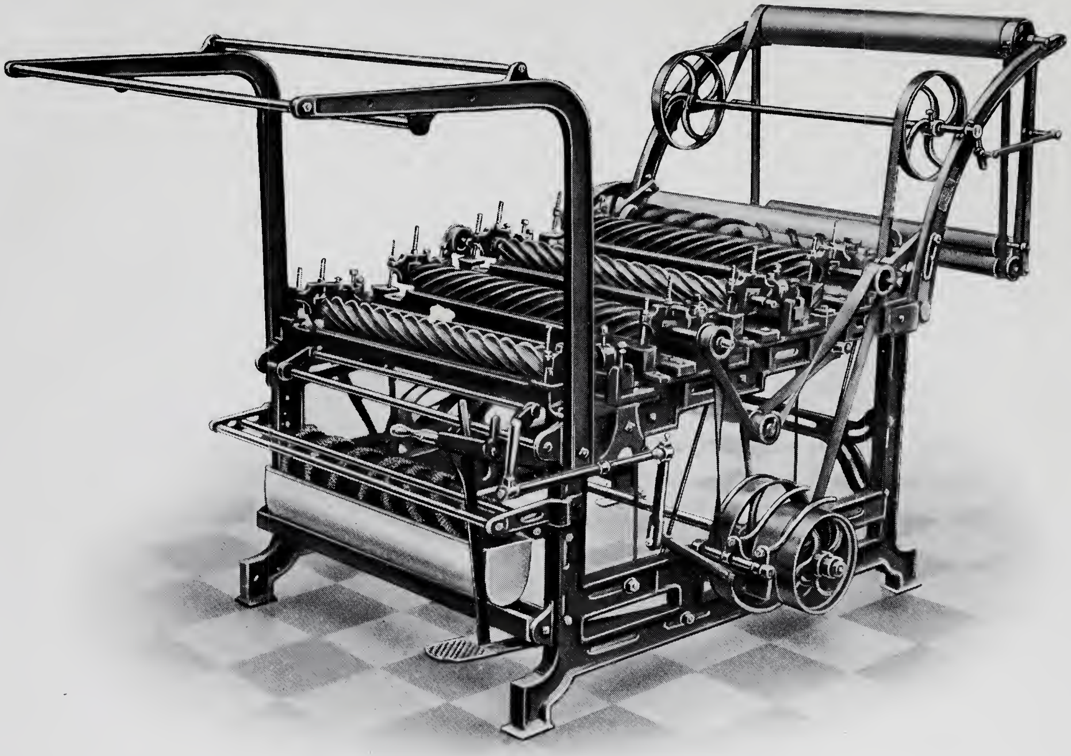


Fig. 39
Four-cutter Shearing Machine (see Page 83).

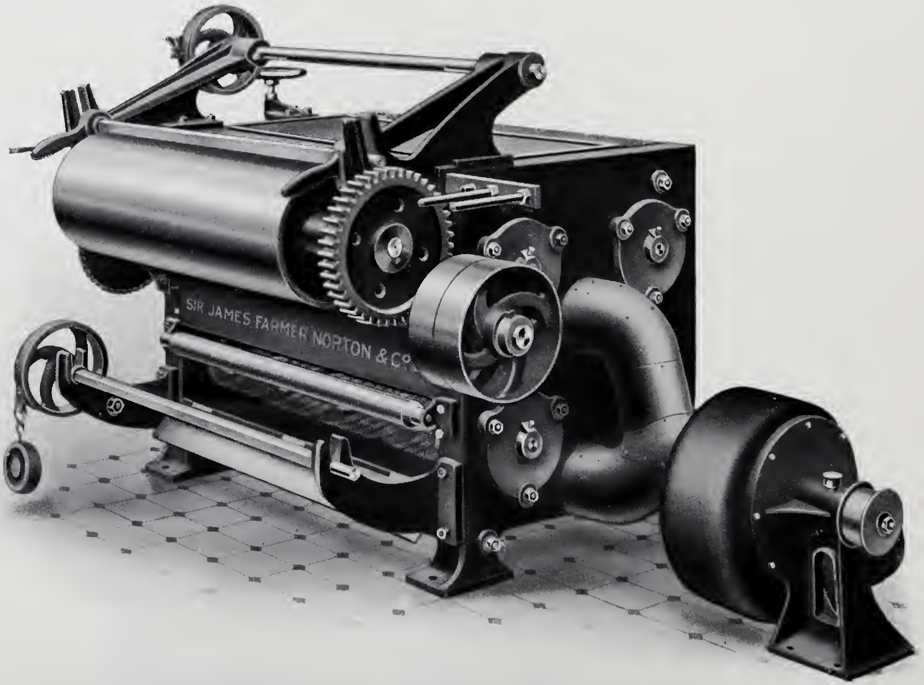


Fig. 40
Four-brush Canroy.

Printing Cotton Piece Goods.

It is not possible in this small book to give an outline of all the operations in Textile Printing, as the method of treatment varies with the colouring matters used and each group of colours necessitates alterations in the treatment of the cloth. It is necessary, therefore, to confine the explanations to machinery and processes employed in some of the simple kinds of printing.

Shearing. To get the best results, the cloth required for printing must be sheared and brushed to remove loose ends of yarn and to smooth the nap and remove dust. Fig. 39 illustrates a standard Shearing Machine. It is fitted with two or four revolving cutters. When threading up, or passing a stitching through the machine, the cutters are raised free from the cloth by means of hand levers.

In the Four-cutter Machine, two cutters operate on each side of the cloth. In the Two-cutter Machine, the cutters operate on one side of the cloth only.

Brushing. After shearing, the cloth is brushed on both sides in a machine fitted with four revolving brushes, Fig. 40. These brushes are completely enclosed in a sheet-iron casing. The lint and dust from the cloth is drawn away by an exhaust fan.

Straightening the Weft. The cloth is thus rendered clean, but for the best class of printing, especially where a square or check pattern is required, it is necessary to have the cloth even in width and straight

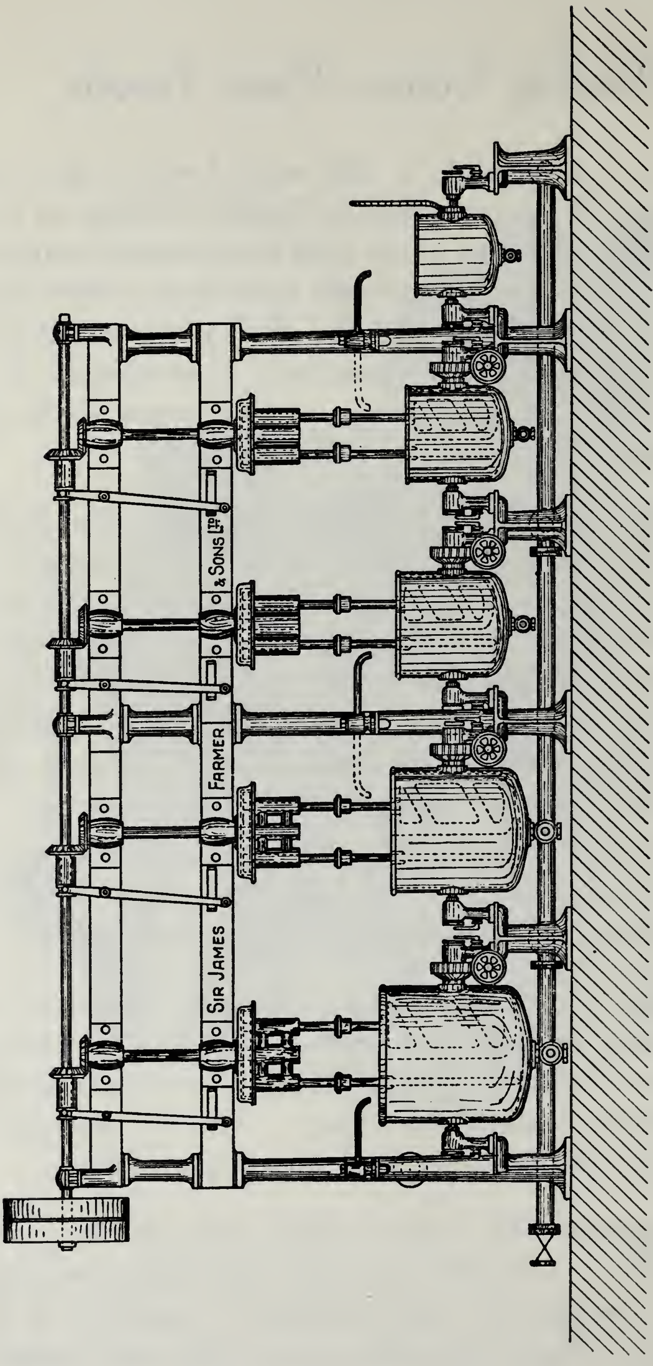


Fig. 41
Colour Pans.

in the weft. To achieve this, it is passed over the Short Stenter, Fig. 24, page 57.

Colour Shop.

Before considering the application of the colour on the printing machine, brief reference may be made to the equipment and uses of the Colour Preparing Department.

Colour Pans. The colours are prepared for printing in copper pans, jacketed and arranged for heating by steam and cooling with water, as required. They are fitted with brass stirrers driven by overhead gearing. The pans are arranged in various sizes and are fitted with tilting mechanism for emptying, Fig. 41.

The various starches and ingredients used for thickening are prepared and mixed with the colours and filtered.

Printing.

Method of Machine Printing. The fabric is printed by impressions received from engraved copper rollers. The colour is contained in a copper box " B," and is supplied to the engraved roller "A" by means of a furnishing roller " C," which is made of wood or of bristle brush. The cloth passes round the large central rotating drum " D " of the Printing Machine, and the engraved copper roller " A " (see diagram No. 42) prints the pattern on to the surface of the cloth.

Mandril Press. Before being used in the Printing Machine, the engraved printing rollers are pressed on to a steel mandril by means of a

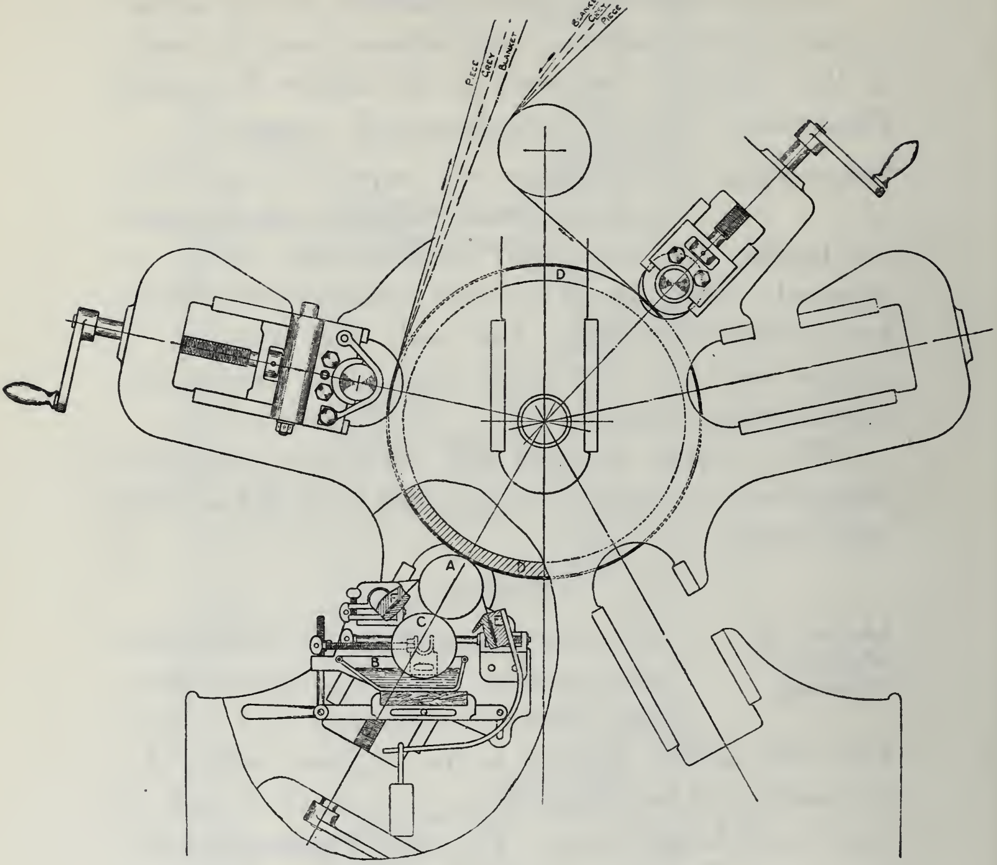


Fig. 42

Diagram shows how the Colour is applied to the Cloth in a Printing Machine.

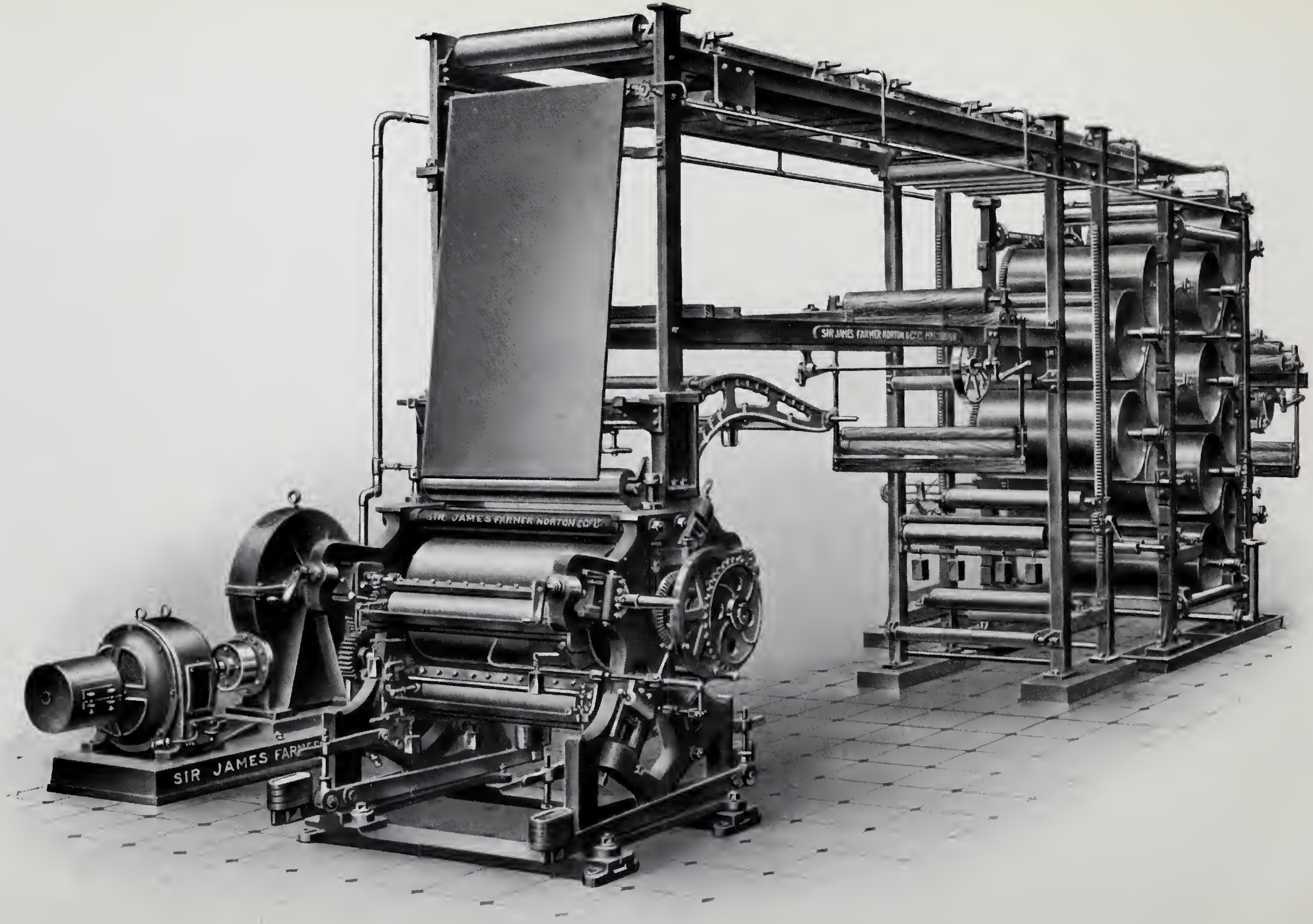

SIR JAMES FARMER NORTON & Co Ld
SIR JAMES FARMER NORTON & Co Ld
SIR JAMES FARME

Fig. 43.
Four-colour Calico Printing Machine.

horizontal screw press. Fig. 43 shows a Farmer-Norton Four-colour Printing Machine with Drying arrangement. The mandrils for the printing rollers are placed in the nips of the Printing Machine. They are an exact fit in the bearings of the machine, and are geared to the central driving wheel, called the star wheel, by means of so-called box wheels. The drive of the machine is transmitted through the star wheel to the box wheels and the printing rollers, and through friction pressure contact, to the central drum. The drying arrangement after printing is driven from the central drum shaft.

Adjustment of the Pattern. Provision is made to adjust each printing roller separately so that the part of the pattern printed by each roller registers into its correct place in the design or pattern printed on the cloth. The box wheels are fitted with worm screws, provided with holes for adjustment, which gear with worm wheels keyed to the mandrils. By turning these worm screws the mandrils are rotated independently of the box wheels, and thus the correct adjustment of the pattern is achieved.

Colour Doctor. The engraved roller is fitted with two doctors, one of which is known as the colour doctor blade " E." This doctor blade scrapes the colour from the surface of the engraved roller, except that which is in the incised part of the pattern, so that the colour sunk in the pattern only is printed on to the cloth.

The doctors are given a to-and-fro motion by means of a cam and levers from the shaft of the central drum.

Lint Doctor. After contact with the cloth, the engraved roller is cleaned by the lint doctor " F." The object of this doctor blade is to remove any bits of grit or thread.

Blanket. The cast-iron central drum of the printing machine is lapped round with layers of cloth to form an elastic cushion, over which is a thick blanket, see Fig. 44. The cloth is delivered into the Printing Machine with unbleached calico underneath it. This is called the "back grey," and protects the blanket by receiving the printing colour which passes outside the selvedges of the cloth.

Back Grey.

Washable Blanket. As a substitute for the "back grey" a blanket is sometimes used which is made of a waterproof washable fabric. Immediately after leaving the Printing Machine it enters the Washing Machine, where it is scrubbed with revolving brushes and well rinsed with water. The washed blanket is then dried over drying cylinders and led back to the Printing Machine, Fig. 45. A short woollen blanket under the washable blanket is also required.

Printing Speed. The speed of cloth in a Printing Machine varies according to the number of colours used. If printed with one colour, the speed of the cloth is about 80 yards per minute ; with three colours, about 50 yards per minute; and with eight colours, about 40 yards per minute.

Drying after Printing.

The cloth must be dried immediately after printing. There are various methods of drying in use.

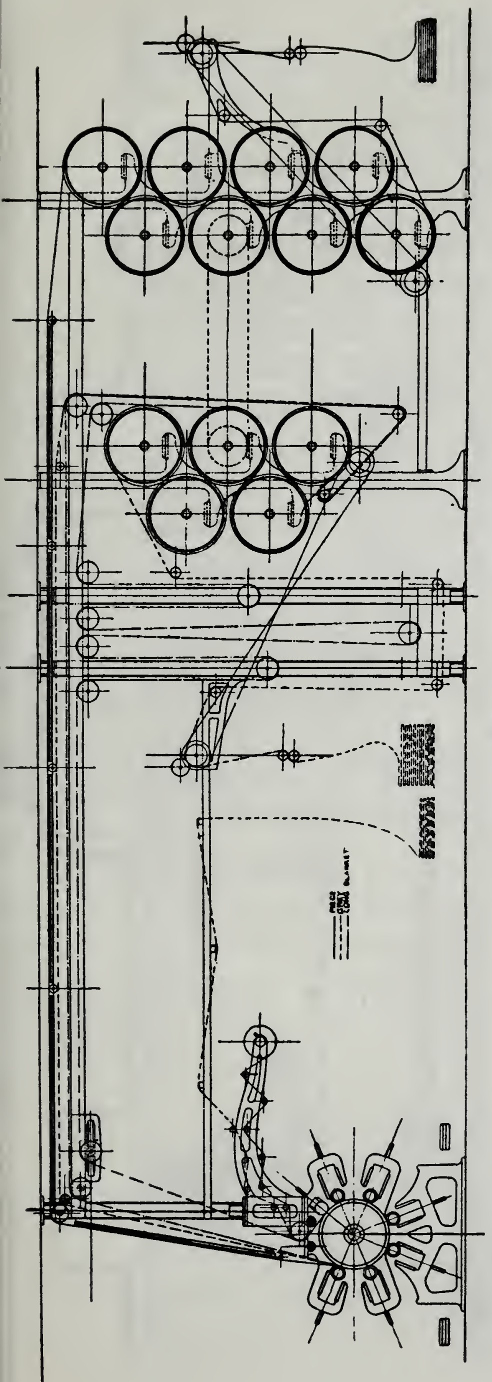


Fig. 44

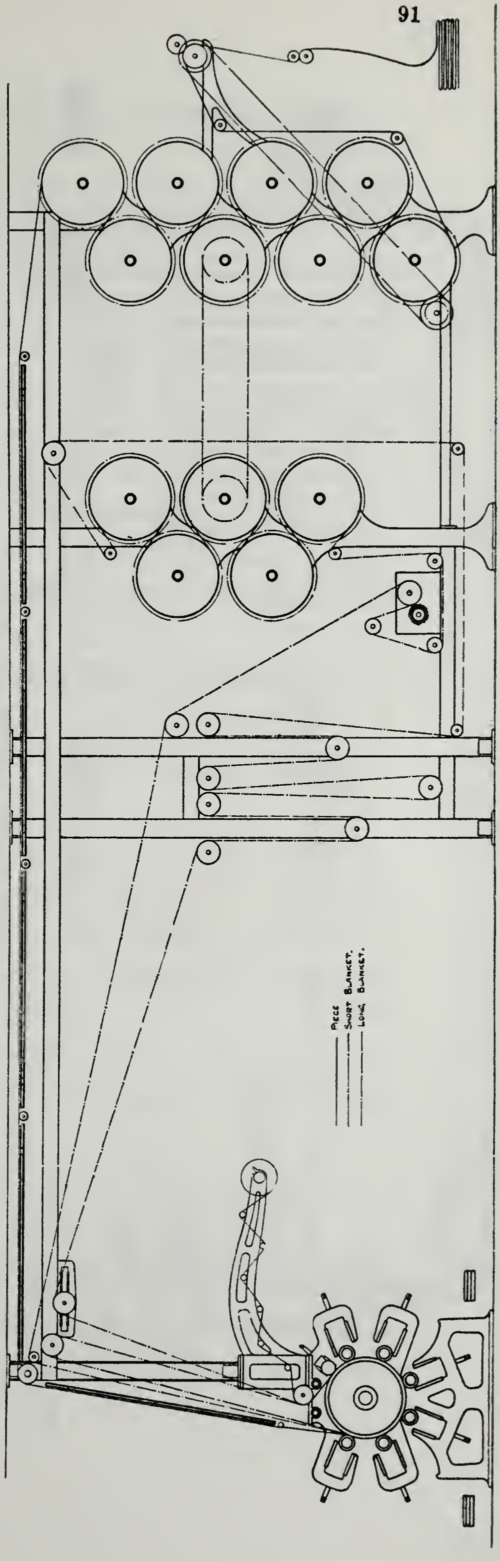


Fig. 45

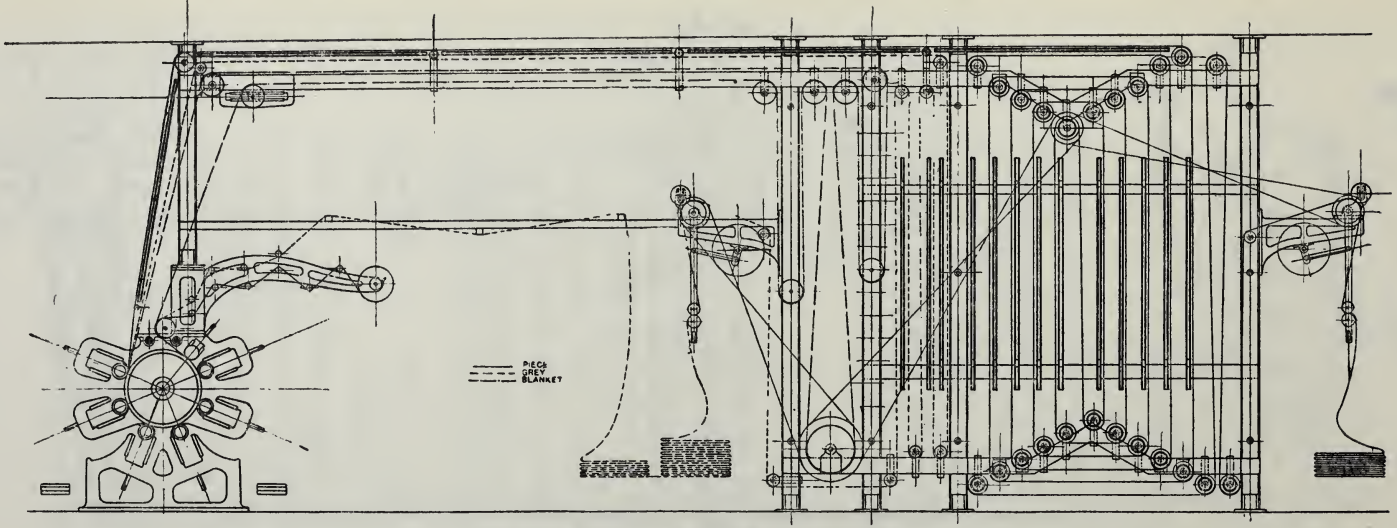


Fig. 46. Drying with Steam Chests.

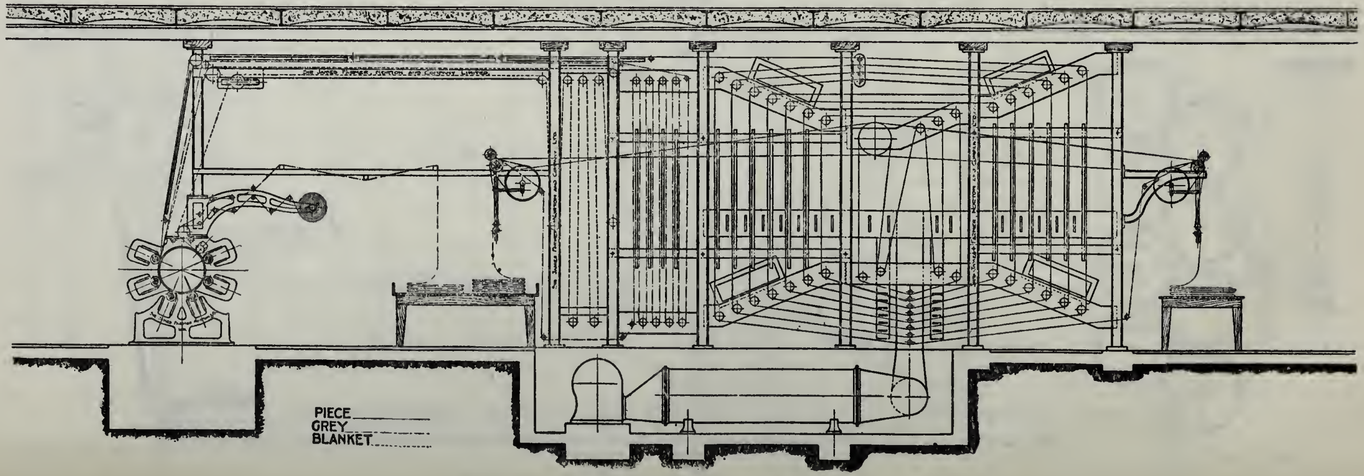


Fig. 47. Drying with Hot Air.

Drying by Steam Chests or Cylinders. On leaving the Printing Machine, the cloth passes over a series of steam-heated iron chests, which are placed above the Printing Machine, and it then enters the drying apparatus, which may consist of a series of drying cylinders as shown in Fig. 44, or a series of steam-heated iron chests, Fig. 46, between which the folds of the cloth are passed over tinned iron guide rollers. The rollers are so arranged that contact with the printed side of the cloth is not made until it is partially dried. This is achieved by running the cloth in a spiral path, over the guide rollers, to the centre of the drying arrangement, where the direction of the cloth is reversed, and the printed side is led over the guide rollers with its face in contact. The object of this arrangement is to prevent smudging of the undried colours, due to contact with the rollers.

Drying by Hot Air. These two drying arrangements are most commonly employed. However, where delicate colours are used, an arrangement of steam chests and hot-air drying is frequently preferred, as is shown diagrammatically in Fig. 47. This apparatus is enclosed in sheet iron to retain the hot air, which is supplied by a fan and multitubular heater.

The blanket and back grey are usually dried in front of the printed cloth. The blanket passes over compensating rollers back to the Printing Machine direct. The back grey cloth passes over rollers and is plaited down. These arrangements are shown in the diagrams.

Steaming after Printing.

Fixing and Developing Colours by Steaming.

After printing, the cloth is generally passed through a process of steaming to fix the colours. In some styles, such as aniline blacks, the colour is developed in the steaming process.

There are two means of steaming in general use—the Continuous Steam Ager and the so-called Cottage Steamer. For some styles of printing, as for example aniline blacks, the continuous process of steaming is employed.

Continuous Steamer.

Fig. 48 shows a standard Farmer-Norton Steam Ager. It consists of a chamber built up of cast-iron plates fitted with steam pipes and heating coils. Inside are two rows of copper rollers, of which some of the upper row are driven. The cloth passes through the machine over the copper rollers in folds, and leaves the machine through the same opening by which it enters. The roof of the chamber is of cast-iron steam-heated chests, to avoid condensation and the possibility of drops of water falling on the cloth. There are outlets in the top and bottom of the back wall for ventilation, each of which is regulated by a shutter. To close the slot where the cloth enters the chamber, a balanced mouthpiece is provided, which is so arranged that it presses lightly against the cloth entering and leaving the chamber, and excludes as far as possible any air. This is very important for colours using hydrosulphite of soda. When used for aniline blacks the mouthpiece is set open to allow air to enter.

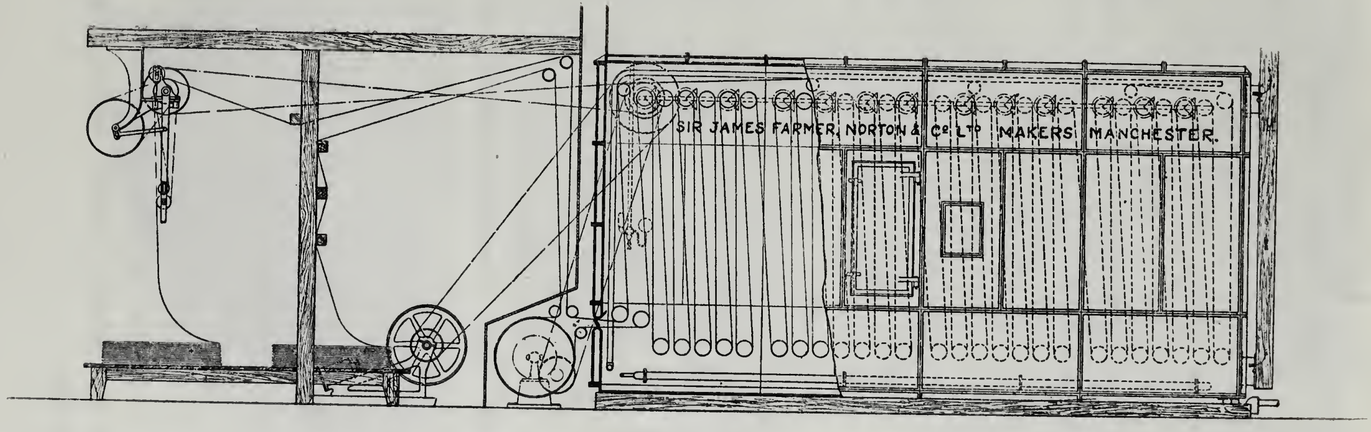


Fig. 48
Steam Ager.

Hydrosulphite Colours. For hydrosulphite colours, the air must be excluded and the top ventilator at the back of the Ager is shut. The bottom is opened only so far as is necessary to allow the air to escape. It is important that the cloth should enter the Ager in a warm condition, and to ensure this it is passed over a steam-heated drying cylinder. The machine usually holds about 150 yards of cloth.

Steaming Cottage. The Farmer-Norton Steaming Cottage is similar to a horizontal boiler, Fig. 49, and is used where the quantity of goods to be steamed is small or where high-pressure steaming is required. The body is of mild steel with a steam-jacketed top to prevent drops from condensation. It has a steel door hinged and fastened with swing bolts. Inside is a wheeled carriage which supports the cloth. The lengths of cloth are carried on square wooden rollers, and to prevent the colours being damaged by prolonged contact with the rollers, mechanism is provided to revolve them slowly from outside the cottage during the steaming process. The carriage, when filled, is run into the cottage and the door is bolted and steam is introduced.

Soaping and Washing of the Colours.

After steaming, the printed cloth is taken to the Dye-House, where the thickening matter, which has been added to the printing colour, is removed and full brightness is given to the colours by soaping and washing on a Farmer-Norton Open Width Soaping Range, Fig. 50.

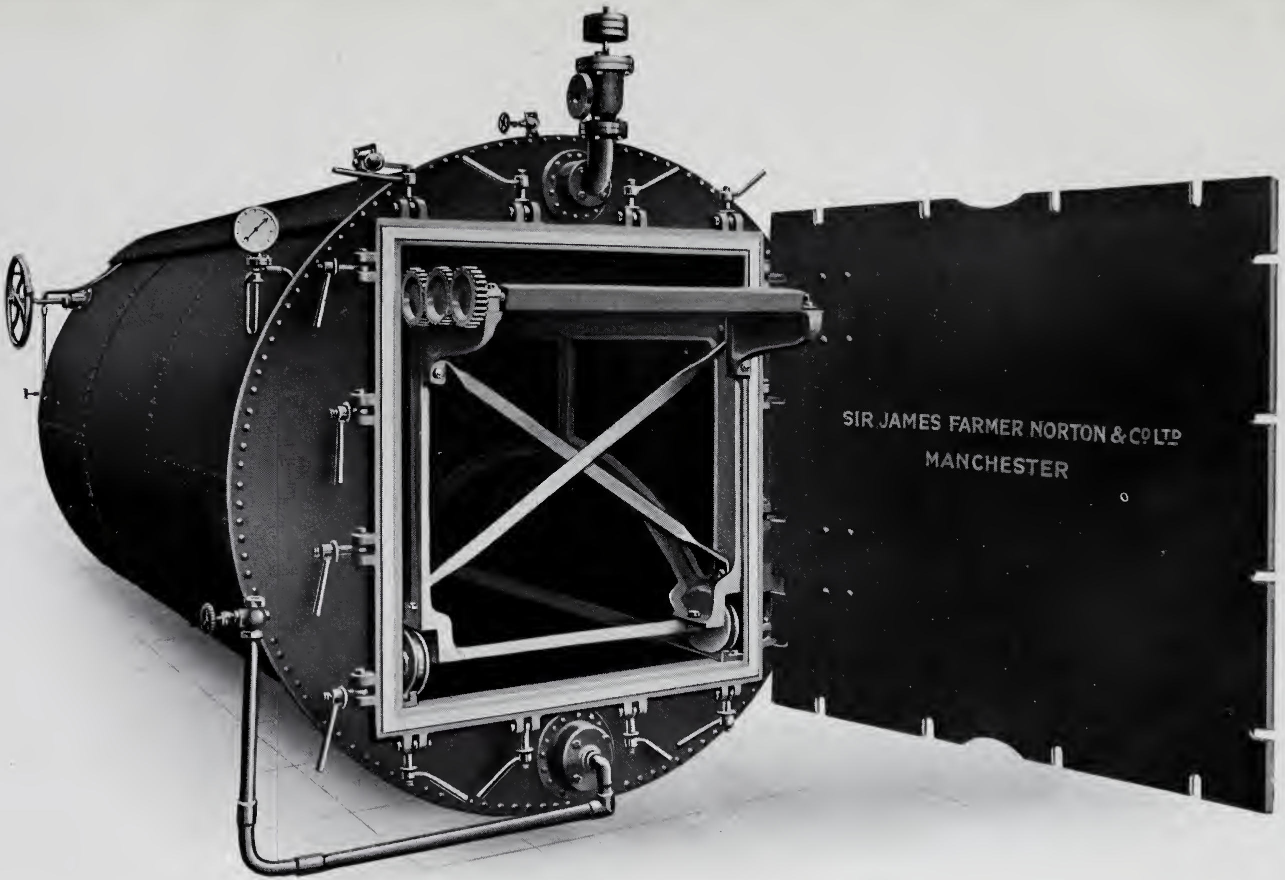


Fig. 49
Steaming Cottage.

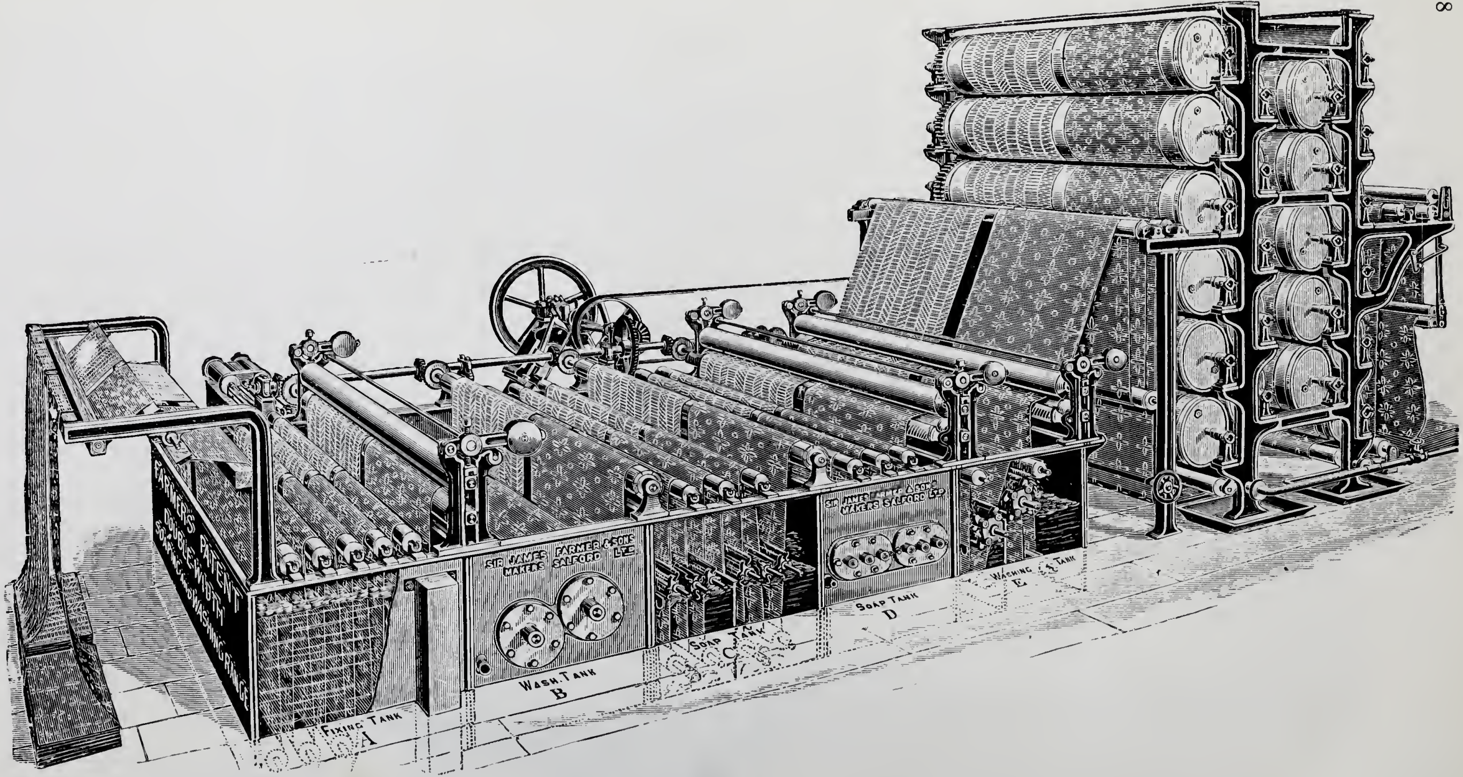


Fig. 50
Open Width Soaping Range.

Open Soaping Machine. This machine consists of a number of tanks placed alongside one another, each provided with two rows of rollers which guide the cloth in vertical folds through the liquor.

Beaters. Some of the compartments are provided with the Farmer-Norton Patent Copper Beaters, Fig. 51, which are placed between the folds of the cloth. They consist of copper oscillating gutters, soldered to steel shafts carried in cast-iron bearers which revolve at a high speed. The beaters, whilst not touching the cloth, partially dip into the water and throw it very forcibly against the fabric, thus subjecting it to a strong vibration and flushing without rubbing, and causing the thickening matter to be loosened from the printed colour.

Squeezing Nips. Pairs of squeezing rollers, placed between the various tanks, help the washing and draw the cloth through the machine. The upper bowls are usually of rubber or sycamore, and the lower of brass or vulcanite. Cam lifting motion and hand levers are fitted to the upper bowls so that they may each be raised instantly when required. The beaters are driven by gearing which is independent of the drive of the squeezer bowls, so that the speed of the beaters may be varied to suit requirements. They are very light, and require little power to drive.

The first tank of an Open Soaper may be used for fixing the printed colour (*e.g.*, basic colours which are fixed by tartar emetic). The tanks which follow are used for washing and soaping.

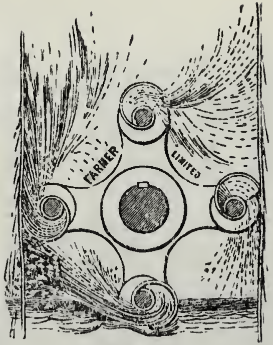


Fig. 51
Copper Beaters.

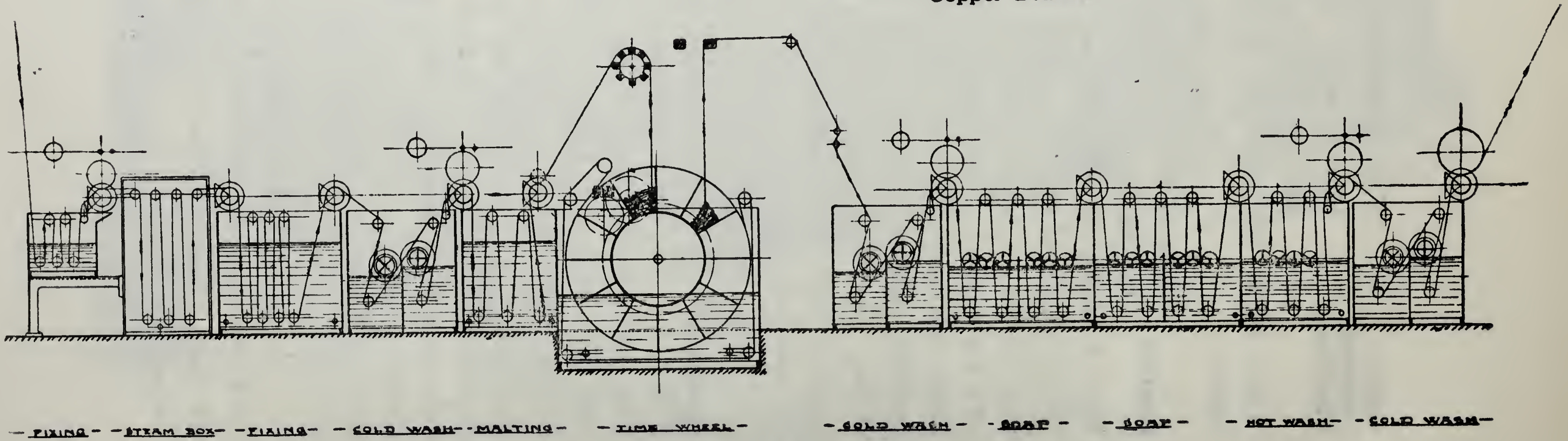


Fig. 52
Open Width Soaping Range with Time-wheel

Malting with Time-Wheel. Open Soaping Machines are frequently fitted with the Farmer-Norton Malting Tank and Time-wheel, described under "Open Width Bleaching," on pages 34 and 35, which are usually placed after the fixing tank and first wash tank, Fig. 52. By this apparatus the printed goods are cleared of their thickening matter in a most efficient way.

The cloth remains in the Time-wheel about 15 minutes, which is sufficient for the diastase to convert the thickening materials so that they are easily removed in the subsequent washing operations.

At the end of the Soaper, the cloth usually passes through a Compound Levered Squeezing Mangle, which removes a part of the moisture before the cloth passes to the Drying Machine. Between the Open Soaper and Drying Machine are placed compensating rollers, which regulate the tension of the cloth.

Finishing of Cotton Piece Goods.

On leaving the Drying Machine after soaping, the cloth is sent to the Finishing Room and is sorted into lots for the particular process required.

Object of Finishing. The fabric in the various bleaching, dyeing and printing operations may have been pulled out of shape, shrunk, creased and made irregular in width and crooked in the weft. It may be dull, limp and harsh to the feel. The object of the finishing process is to restore to the cloth the qualities which it has lost and to give it the best possible appearance to suit the requirements of the market.

Starching.

Starching Ranges. Cloths which require starching or filling with weighting material are passed through the Starch Mangle and dried on the Drying Machine, Fig. 21, page 50.

Cloths which are printed with delicate colours and figured and pile fabrics are dried on the one side only in order to preserve the face of the material. A Vertical Drying Machine arranged for this purpose is shown in Fig. 53. Each cylinder is provided with two binding rollers round which the cloth is guided to keep the same side of the material in contact with the heated cylinder.

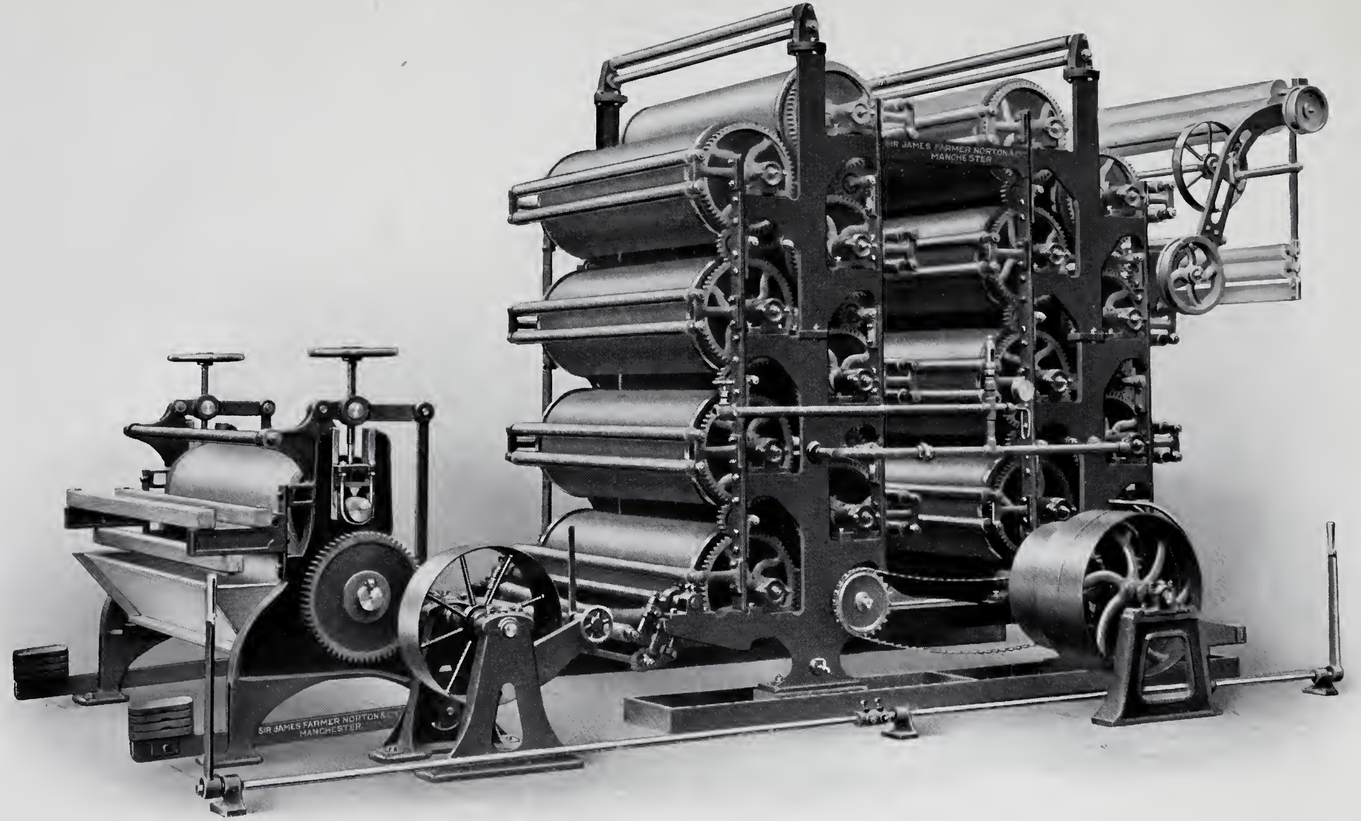


Fig. 53
Starching and Drying Range arranged with Cylinders to dry one side of Cloth.

Farmer-Norton Back-Fill Range for Prints. Printed cloths are often heavily filled on the back of the cloth. A back-fill range consists of a special mangle, one or more 6-ft. steam-heated cylinders, and a horizontal range of drying cylinders, Fig. 54. The cloth passes over stave rails and guide rollers to the special Two-bowl Mangle. This mangle can be used for ordinary starching or for back filling. When used for back filling, the top bowl " B " is raised out of contact with the lower bowl " A," which revolves in a starch trough fitted with an agitator " C " to keep the filling thoroughly mixed.

A copper doctor roller " D," which is adjustable horizontally, regulates the film of starch which the roller " A " imparts to the cloth. A brass doctor " E," adjustable vertically, spreads the filling and may be tilted to any desired angle.

Two copper guide rollers " F," adjustable vertically, enable the cloth to be brought into contact with the starch roller " A." On leaving the Starch Mangle the cloth is led round the 6-ft. cylinder with its face to the cylinder and the back of the cloth is partially dried before passing to the remaining horizontal drying cylinders.

Stentering.

For many high-class finishes the cloth is filled on a mangle and then dried on a Farmer-Norton Hot-air Stenter in order to increase the width, straighten the weft and obtain the peculiar feel to the cloth, which only a stenter can give, Fig. 55.

During the bleaching operation, the cloth has shrunk often to a considerable degree, but almost the original width can be regained on the Stentering

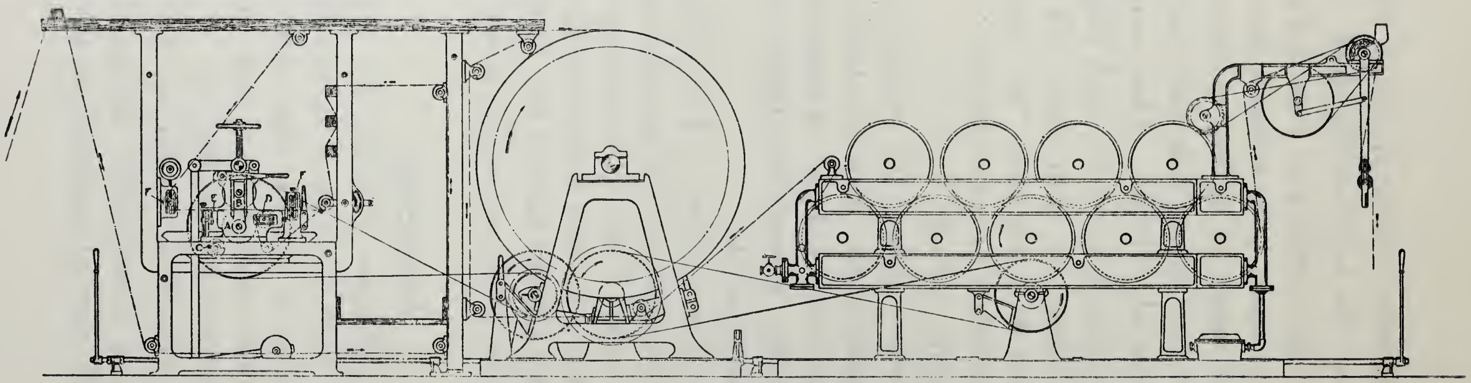


Fig. 54
Back Fill Range for Printed Goods.

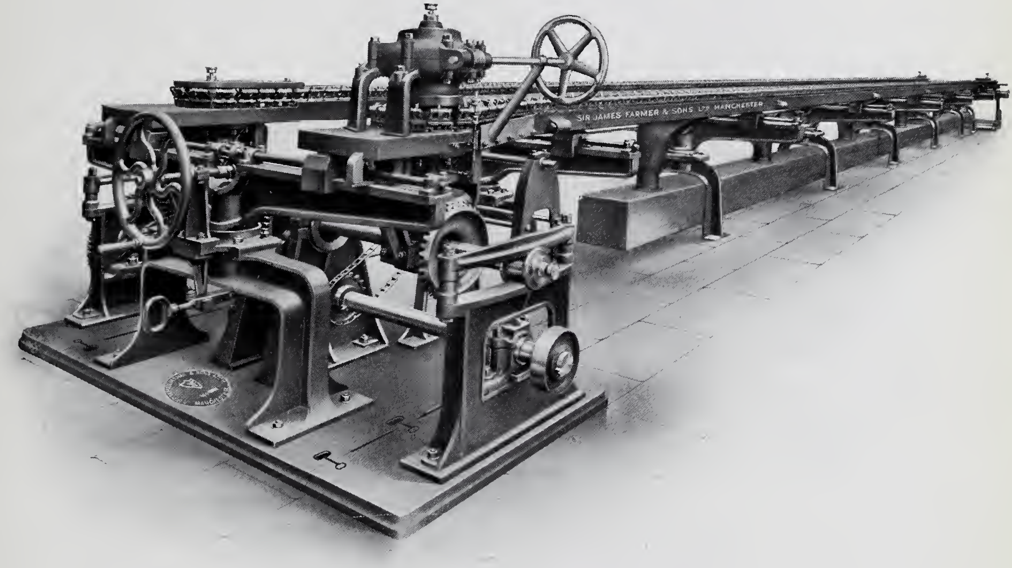


Fig. 55
Hot-air Jig Stenter.

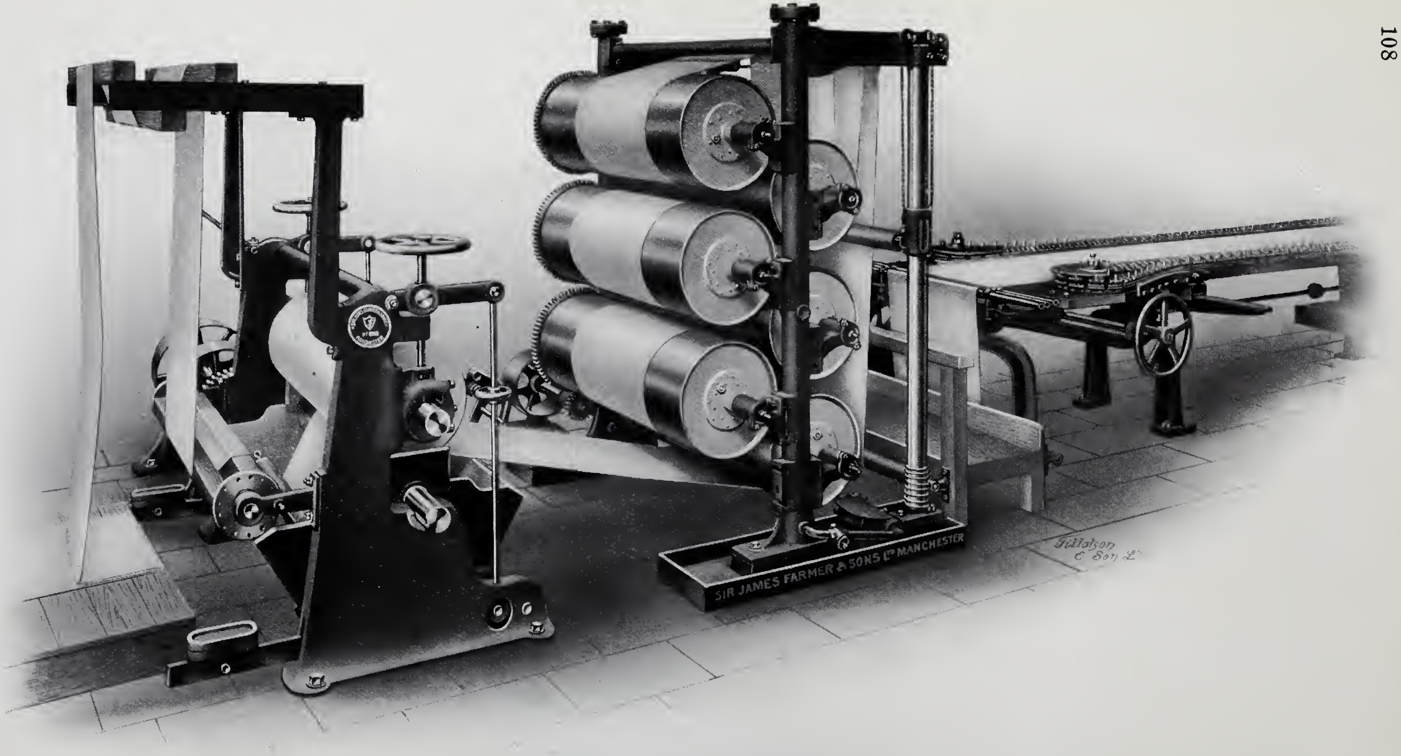


Fig. 55a
Entering End of Starching, Drying and Stentering Range.

Machine. The action of the hot air gives the cloth the natural appearance of the weave and a springy feel, which cannot be done on steam-heated drying cylinders.

Farmer-Norton Hot-Air Stenter. Fig. 57 shows diagrammatically a Hot-air Starching and Drying Stenter. It consists of a Two-bowl Starch Mangle with trough, in which the cloth is starched before it passes through the nip of the mangle. Following the mangle are six steam-heated copper cylinders over which the cloth is passed to commence the evaporation of the moisture (see Fig. 55a). It is then led over compensating rollers, which give warning to the attendant of any undue tension of the cloth between the drying cylinders and the Stenter. The speeds of the various parts of the range are regulated by means of cone pulleys and belts. The cloth passes under the platform to the entering end of the Stenter where an attendant removes any curled selvedges and controls the feeding into the clips (Fig. 55a). Automatic apparatus, controlled by electricity or compressed air is often used for feeding the material into the clips. The cloth is gripped by the clips at either selvedge. Fig. 56 shows the action of the clip mechanism. The chains of clips for the first 10-ft. of rails gradually diverge from each other, and thus apply the stretch gradually.

Method of Drying. The cloth is carried by the clips in the stretched condition for the length of about 80-ft. Hot air is blown on to the cloth by a powerful fan from a large multitubular heater through sheet-iron air trunking and adjustable nozzles. The air is delivered through the nozzles above and below the cloth, or on to the underneath side only (Fig. 57). The nozzles can be adjusted to deliver the air towards or against the direction in which the cloth is moving, or towards the selvedge or the centre, and the nozzles are fitted with adjustable dampers. On leaving the clips the material, if of heavy texture, should be passed over three or four steam-heated cylinders to remove any moisture which may remain in the selvedges where they have been gripped by the clips. Mechanism is provided by means of which one of the clip chains may be accelerated or retarded in order to straighten the weft.

Jig Motion. Stenters are usually provided with a so-called jig motion, which is specially used for cloths requiring an elastic finish. The jig motion is produced by the horizontal clip-rails being moved forward and backward. The rails are supported by trunnions carried on cast-iron cross rails, moving on pivots at their centres. The jigging movement is given to the cross rails by connecting rods and eccentrics with an independent variable speed drive.

Air Re-circulation. The stenter is usually enclosed in a wooden chamber to avoid loss of heat, and part of the hot air from the chamber is re-circulated through the fan and heater, and steam is thus economised.

Output. The output of the machine depends on the weight of the cloth, and the amount of moisture to be dried. Usually these machines are made with a 90-ft. length of clip chains and the speeds range up to about 120 yards per minute.

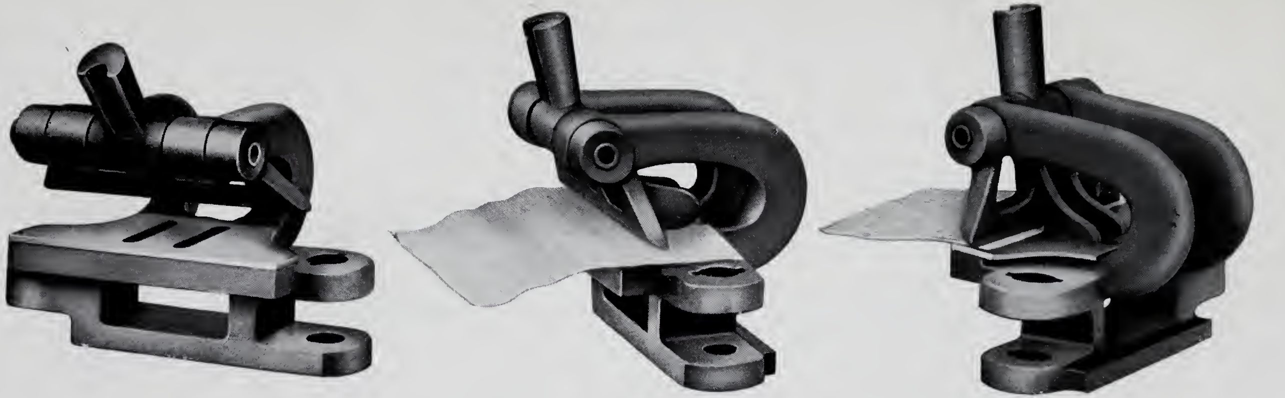


Fig. 56 Stenter Clip.

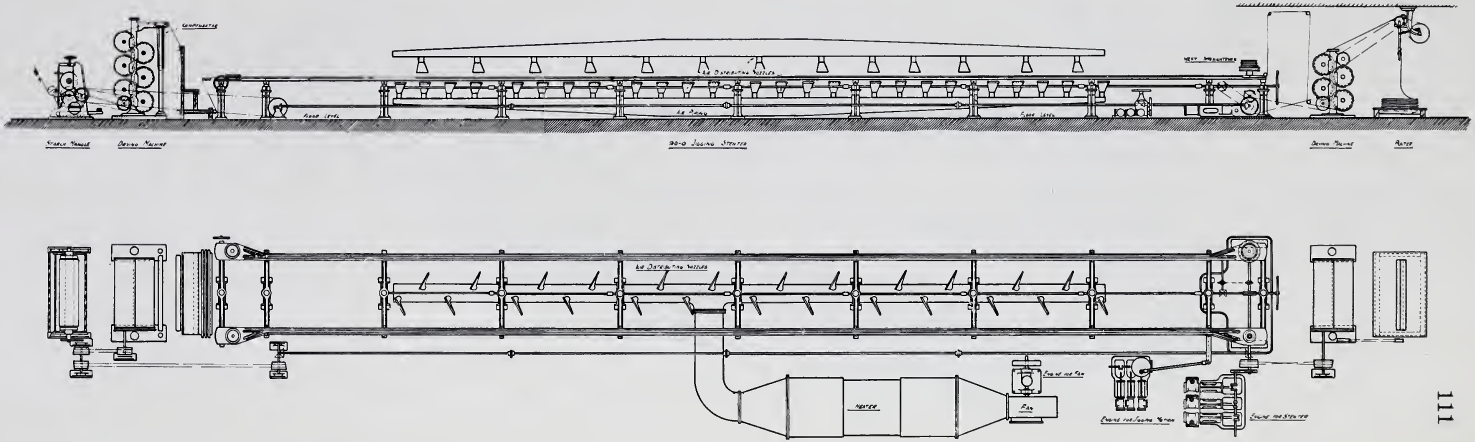


Fig. 57 Arrangement of Starching, Drying and Stentering Range.

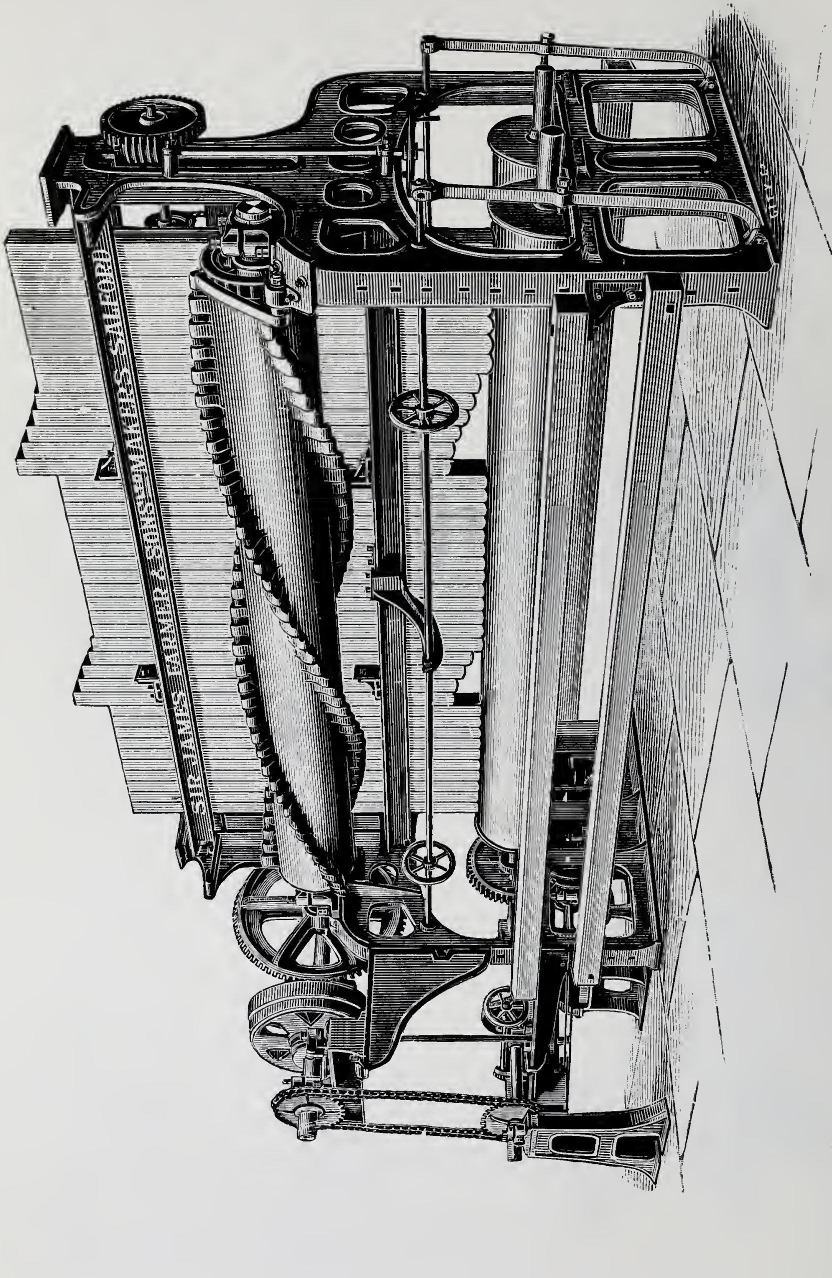


Fig. 58 Beetle.

Stentering machines can be driven either by electric motors, by specially designed steam engines, or by belts.

After the starching and drying, the cloth is conditioned and calendered (see White Finishing).

Beetling.

The Beetling process closes the threads of the cloth and gives it a soft " feel " and thready appearance, and increased width. The " feel " depends on the amount of moisture in the cloth before treatment. Beetling is applied to the finishing of linen and some qualities of cotton shirtings, sateens, linenettes, drills and hollands, and it is also used for closing the threads of low quality dyed and white goods.

Farmer-Norton Lancashire Beetle.

No machine has yet been devised which will give the finish produced by the Lancashire type of Beetle, Fig. 58. The machine consists of heavy frames supporting, usually, 41 hard beech-wood faller stamps, which are actuated by cams fastened to a horizontal shaft called the " wiper beam." The cams lift the fallers and allow them to fall on to the roll of cloth on the strong iron beam underneath. There are two cloth beams, each about 14-ft. long, which receive two, three or four pieces of cloth, according to the width of the material. One beam, on which is the roll of cloth, is subjected to the hammering action of the fallers in the centre of the machine, and the beam is slowly revolved and at the same time moved to and fro in a longitudinal direction so as to distribute the hammering evenly over the whole surface of the material.

At the same time the cloth is wound on or unwound from the other beam placed at the side of the machine.

When the beetling operation is finished, the central beam is moved to the side for unwinding, and the side beam is moved to the central position for beetling.

After the cloth has been once beetled it is rewound so that the material which was on the outside, after rewinding is on the inside, and it is again beetled. The finish is thus distributed evenly through the material.

Schreiner Finishing.

Description of the Process.

Schreiner finishing, like mercerising, gives a silk-like brilliance to cotton fabrics. It is universally employed to-day on a large scale and has almost completely supplanted the finish formerly obtained by a Hot Press.

It is chiefly used on cotton linings, sateens, venetians and printed cloths. When produced on mercerised cloths it gives the nearest possible resemblance to silk, and for this reason has replaced many of the former lustring finishes.

Schreiner finishing is a form of embossing. A large number of lines, from 5 to 20 lines per m/m., are embossed on to the cloth. The engraving is so cut on the steel bowl that the lines form a slight angle with the weft or warp. In weft sateens, for example, the best finishes are obtained with lines at an angle of about 20 degrees to the weft in the direction of the twist of the yarn. Ordinary calico is also greatly

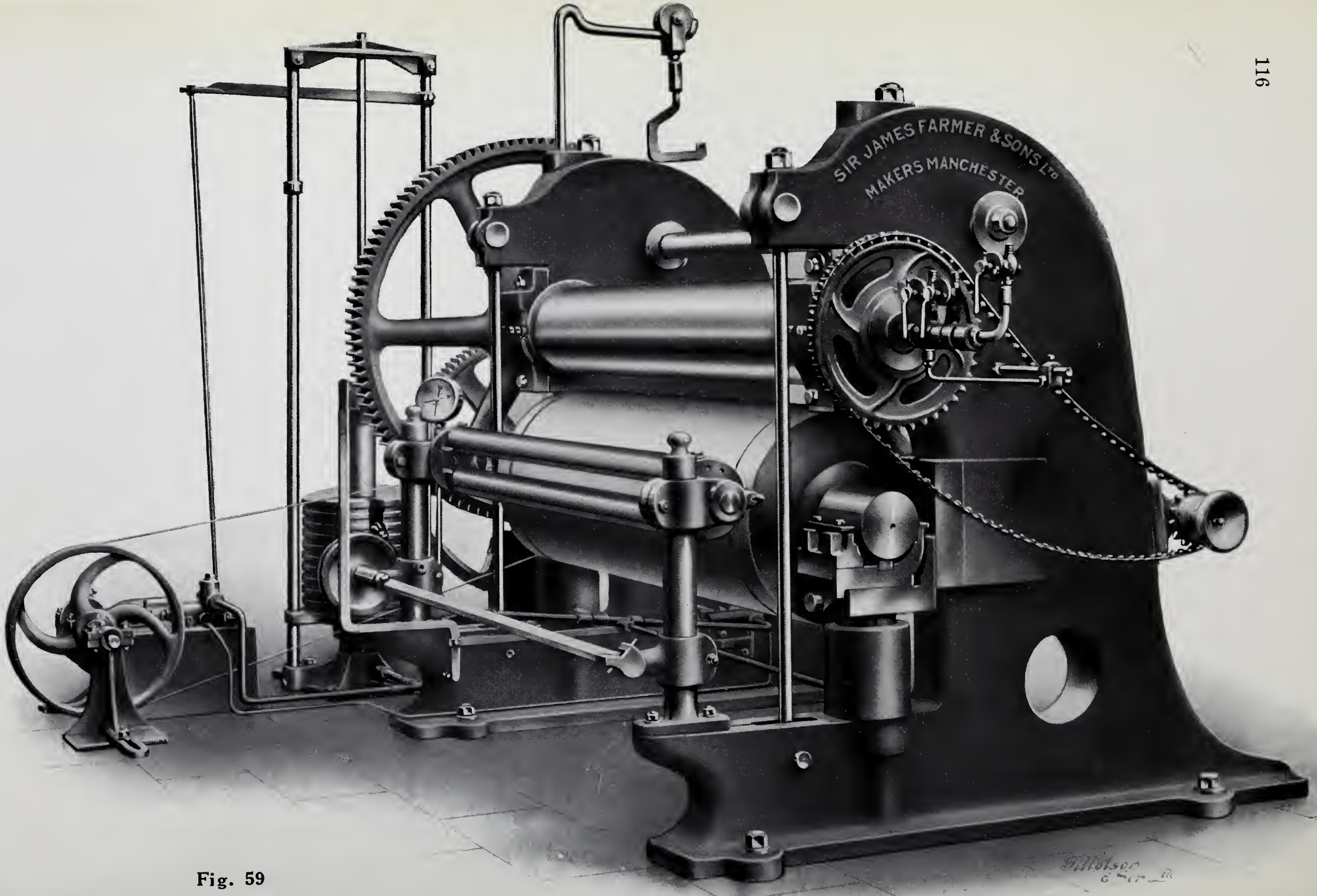


Fig. 59
Hydraulic Schreiner Calender.

improved by the Schreiner finish. In this case the engraving is coarser than for sateens and is generally about 6 or 7 lines per m/m.

The Hydraulic Schreiner Calender.

The Farmer-Norton Schreiner Calender has strong frames carrying two bowls, Fig. 59. The top bowl is of special fine-grained steel, which is engraved with the required number of lines and is heated by gas. The bearings of the top bowl are water-cooled. The bottom bowl is of compressed cotton or paper, and is pressed to a hardness suitable for the requirements of the finish. Pressure is given to the bowls by means of hydraulic rams underneath the bearings of the bottom bowl. The cloth is subjected to very heavy pressure whilst passing between the bowls. The Calender, Fig. 59, is fitted with a relief valve which allows the bowls to be instantly separated. The bearings of the lower bowl are provided with a skewing arrangement by which the bowl can be set at any angle to the top bowl, Fig. 60. This setting is done by means of special screws shown in Fig. 59. By using this skewing arrangement an enhanced brilliance is given to the finish.

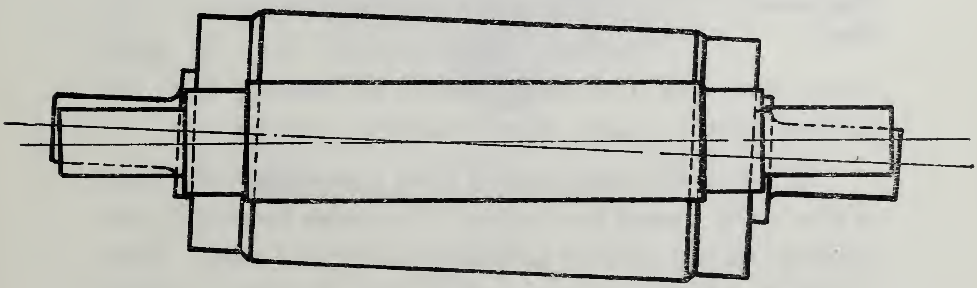


Fig. 60

Diagram showing Bowls skewed.

An accumulator with adjustable weights regulates the hydraulic pressure supplied by means of a pump, driven from the Calender, which works automatically with the accumulator. The relief valve gives direct communication between the hydraulic cylinders and the accumulator, closes this passage and discharges the pressure by returning the water to the pump tank. This valve is operated by a hand lever placed in convenient reach of the calender man.

The Calender is fitted with let-off apparatus, swivel stave rails, and batching-up or plaiter at the going-out end.

Permanent Finishes.

The so-called radium and permanent finishes are also done on this machine, the cloth being first treated with soluble oil, and then put through the bowls in a wet state under high temperature and pressure.

Farmer-Norton Natural Lustre Finishing Machine.

Purpose for which the Lustring Machine is used.

The finishing of poplins, brocades, repps and cloth with a woven pattern, often requires special treatment. The finished cloth should have a good lustre and soft feel and fulness of thread, but the pattern of the weave should not be crushed.

If the cloth were passed over a calender, the face of the cloth would be crushed. In order to obtain the desired effect a special finishing machine is used. This is called a Natural Lustre Finishing Machine, and is illustrated by Fig. 61.

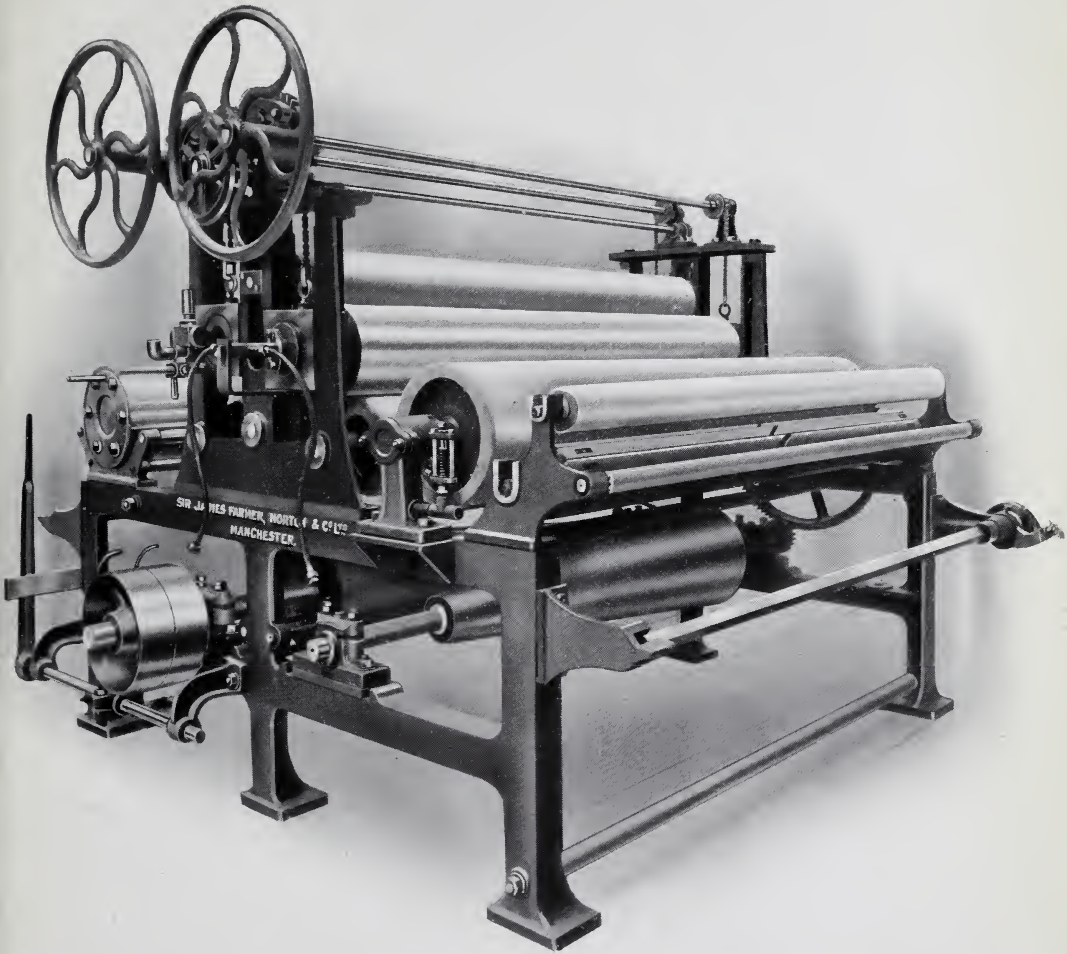


Fig. 61
Natural Lustre Finishing Machine.

Description of the Machine. The cloth on leaving the batch is guided over an expanding roller to a steam-heated cylinder covered with felt. Between the batch and heated cylinder the cloth is damped on the face with steam from a perforated pipe. It then enters a set of felt-covered calender rolls, over which are placed two highly-polished steam-heated iron rollers, which rest with their own weight on the felt rolls.

A slight drag on the cloth is arranged between each set of rolls. The top rollers can be lifted out of contact with the felt rollers by the chains and hand-wheels shown on the illustration. Whilst passing between this arrangement of rolls the cloth receives a polish or lustre.

On leaving the glazing rolls the material is drawn tightly round a steam-heated polished steel cylinder. The object of this cylinder is to drive the moisture through the cloth and to raise the rib, twill or figured pattern of the cloth, which would be partly flattened by the calendering process.

Making-up and Packing.

After finishing, the cloth is made up and packed suitably for the requirements of the different markets.

It should be first examined by the maker-up for faults or damage caused during the various processes, and also to ascertain if the finish is correct.

The standard machines used for making-up are briefly as follows :—

The Plaiting Machine, Fig. 62, plaits or lays the cloth in regular folds. It is constructed with swivel grip rails which receive their motion from a cam, and are faced with rubber to prevent injury to the cloth. This machine is fitted with a regulating motion which alters the length of the plait or fold as required. It will plait at a speed of about 90 yards per minute.

THE ROLLING AND LAPPING MACHINE, Fig. 63, is used for lapping the cloth on boards, and is fitted with a measuring apparatus, and expanding swords for different widths of cloth.

THE TRADE MARK STAMPING MACHINE, Fig. 64, stamps the folded cloth in one or more colours, as quickly as the pieces can be fed into and taken from the machine. It gives perfect impressions at a speed of 900 to 1,500 pieces per hour.

After the goods have been made up, they are usually taken to a hydraulic press where they are given the necessary pressure to retain their shape and consistency.

The cloth is wrapped in attractive packages, with distinguishing labels denoting the pattern, quality, measurements, and other details required for the market.

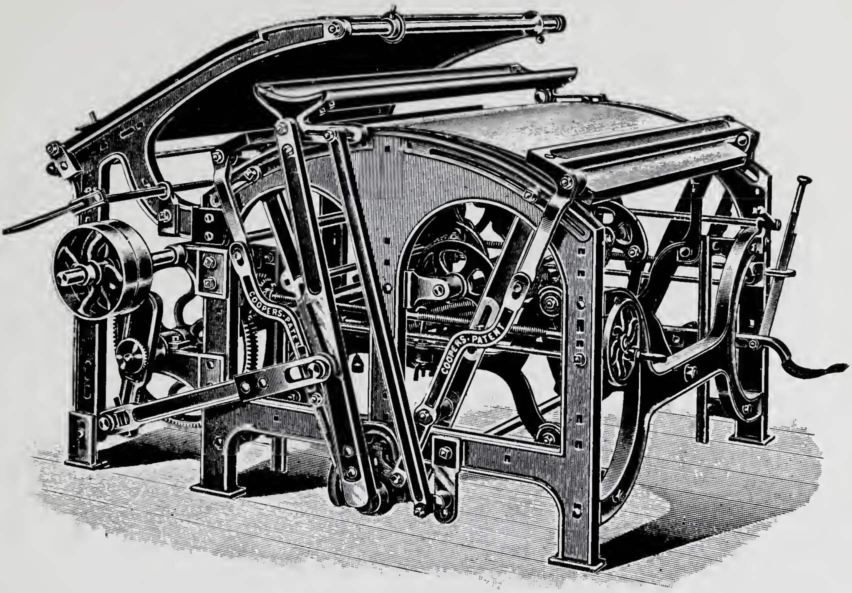


Fig. 62
Plaiting Machine.

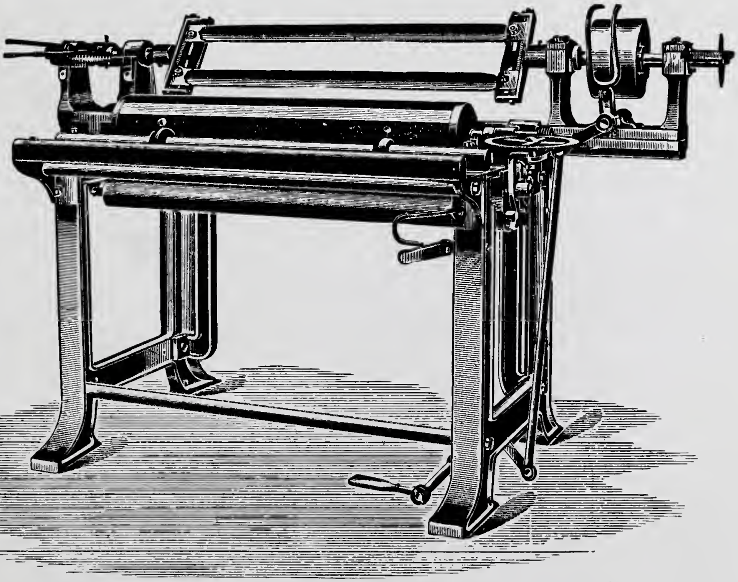


Fig. 63
Rolling and Lapping Machine.

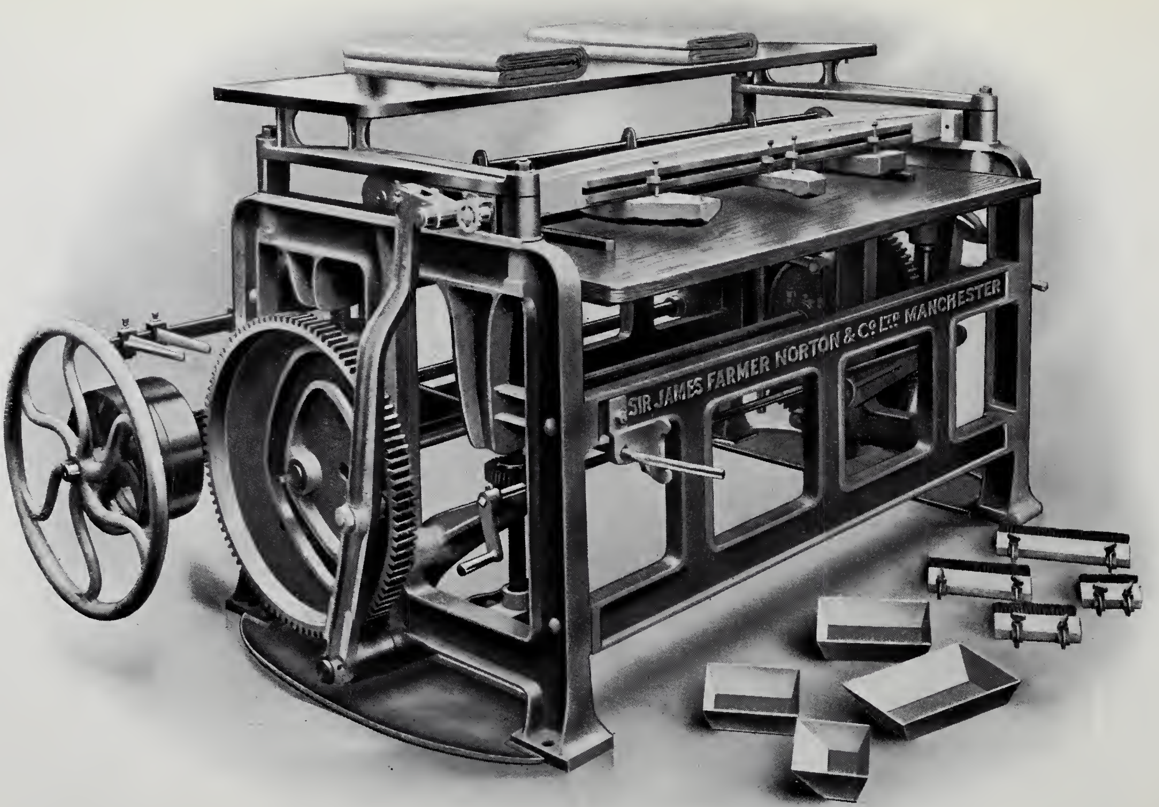


Fig. 64
Trade-mark Stamping Machine.

LIST OF ILLUSTRATIONS.

PAGE
Aniline Black Dyeing Range (Copper) 70
Automatic Piling Machine 12
Back Fill Range for Printed Goods 106
,, Mangle for White Cloth 46
Belt Stretching Machine 55
Beetle 112
Bleaching Jigger 36
Bleach-croft Washing Machine 18
Diagram showing Bowls skewed 117
Brush Damping Machine 52

CALENDERS.

Seven-bowl Calender 58
Three-bowl Heavy Friction Calender 61
Five-bowl Universal Calender 62
Six-bowl Imitation Beetle Calender 63
Ten-bowl Swizzing Calender 64
Four-brush Canroy 82
Continuous Open Width Bleaching Machine with Time-wheel 37
Developing Range for Para Red 75
Dye Jiggers 67
,, for Sulphur Colours 67
Dye-house Mangle 68
Drying Machine, Horizontal 27
,, Range for Back-filled Goods 48
,, Machine, Vertical 28
Drying after Printing, by means of Cylinders 91
,, ,, ,, ,, Cylinders with Blanket Washer 91
,, ,, ,, ,, Steam Chests 92
,, ,, ,, ,, Hot Air 92
Dye Jigger for Vat Colours 68
Gas Singeing Machine 11
High-pressure Kier with Multitubular Heater and two Manholes 17
,, ,, ,, Central Manhole 15
Horizontal Kier 34
Hot Flue 73
Indigo Dyeing Machine 77
Malting Tank and Time-wheel 32
Mercerising Range with one Impregnating Mangle 39
,, ,, two Impregnating Mangles .. 45
Methods of Threading for Swizzing, Chasing and Friction Finishes 59
Open Soaping Range 98

LIST OF ILLUSTRATIONS—*continued.*

PAGE
Open Width Washing and Souring Machine 35
Open Soaping Range with Time-wheel 100
Natural Lustre Finishing Machine 119
Padding Mangle 33
Plan of Bleaching, Dyeing, Printing and Finishing Works 29
Plaiting Machine 123
Plate Singeing Machine.. 9
Printing Machine with Four Colours.. 88
,, ,, Diagram—shows how the Colour is applied to the Cloth in a Printing Machine 86
Rolling and Lapping Machine 123
Scutcher 22
Sewing Machine 7
Schreiner Calender 116
Shearing Machine with four Cutters 81
Starching and Drying Range 50
Starching and Drying Range, arranged to Dry one side of the Cloth 103
Steam Ager 95
Stenters—Short Stenter.. 57
Hot-air Jigging Stenter 107
Entering End of Starching, Drying and Stentering Range 108
Stenter Clip 111
Arrangement of Starching, Drying and Stentering Range (diagram) 111
Squeezer 23
Steaming Cottage 97
Three-bowl Water Mangle 24
Trade-mark Stamping Machine 124

INDEX.

PAGE
Acids used in Bleaching 19
Ager for Steaming Colours 95
  ,, Copper Aniline Blacks 70
  ,, Prussiate Aniline Blacks 72
Air Circulation on Stentering Machines 110, 111
Aniline Black Processes 69–72
Back Grey 90
Back-filling for White Goods 47
  ,, Printed Goods 105
Beater—Farmer Patent Beater for Open Soaping Machines 99
Beetle, Lancashire type 113, 114
  ,, Calender 60 & 63
Blanket for Printing 90
  ,, Washing Machine 90
Belt Stretching Machine 54, 55
Bleaching Powder 20
  ,, ,, Electrolytic 20
Bleaching in Open Width 32–38
Bleaching, Continuous Open Width Process 37, 38
Bleach Works (see Plan of Bleaching, Dyeing, Printing and Finishing Works) 29, 30
Boiling, methods of Kier Boiling 14
Box Wheels on Printing Machines 89
Brushing Machine 83
Brush Damping Machine (see Damping Machine) 52–54
Cascade Washing on Mercerising Range 43
Caustic Soda, collection and concentration on Mercerising Range 43
Caustic Soda used in Kier Boil 14, 19
Conditioning Cloth 53
Calender Finishes. Chasing, Friction, Imitation Beetle, Swizzing 59, 60
  Schreiner 114–118
Calender Speeds 65
Chemicking, methods of 19
Chlor. (see Chemick).
Chroming Machine for Aniline Blacks 70, 71
Clips, Stenter 109, 110
Cloth Preparation for Printing 83
Colour Box 85, 86
  ,, Doctor 89
  ,, Mixing Pans 84, 85
Croft Washing Machine 18, 19
Cylinder Drying Machines 25
  Notes on same 26
Damping Machine 52–54

INDEX—*continued.*

	PAGE
Direct Dyes Application	66
Doctors on Printing Machine	89, 90
Drying Machine, Horizontal	25, 27
,, ,, Vertical	26, 28
,, ,, arranged for Drying one side of Cloth	102, 103
Drying after Printing (Cylinder type)	91, 93
,, ,, with Blanket Washer	90, 91
,, ,, with Steam Chests	92, 93
,, ,, with Hot Air	92, 93
Dyeing Machinery. Dye Jiggers for Direct Dyes	66
,, ,, Sulphur Dyes ..	67, 69
Special Dye Jiggers for Vat Colours	68, 69
Dye-house Mangle	68, 69
Electrolytic Bleach	20
Engraving for Schreiner Finish	114
Feeding Apparatus, Automatic for Stenters	109
Finishing Machinery (see Plans of Works)	29, 30
Folding Machines (see Plaiting Machine)	122, 123
Finishing of White Cloth	47–65
,, Printed and Dyed Cloth	102–121
Fixing Colours by Steaming	94–96
Gas, Anthracite Producer Gas	13
,, consumption on Gas Singeing Machine	13
,, Singeing Machine	10, 11, 13
Hot Flue	72–74
Hydraulic Schreiner Calender (see Schreiner Calender).	
Hypochlorite of Soda, Electrolytic Process	20
Hot-air Drying on Stentering Machine	109–111
Indigo Dyeing ,, Dyeing Machine ,, White	76–78
Jig Stenter	105–113
Kier, High-pressure, with two Manholes	14–17
,, ,, ,, Central Manhole	14, 15
,, Horizontal	34, 36
Lapping Machine	122, 123
Liming	14, 20
Lint Doctor	90
Lustre, Natural Finishing Machine	118–121
Mangles. Dye-house Mangle	68, 69
Padding Mangle	33, 69, 71, 72
Starch Mangle	53
Water Mangle	25
Mandril Press	85
Malting Apparatus	34, 35, 100, 101
Mercerising after Bleaching	44
,, before Bleaching	44
,, Effect of	41
,, Heavy Cloth	44

INDEX—*continued.*

PAGE
Mercerising Mangle 41
  ,, Range 41
  ,, Recovery of Caustic 42
  ,, Stenter 42
Beta-Naphthol 72
Naphthol A.S. Red 76
Open Width Bleaching 32–38
  ,, Soaping Machines 96–101
Padding Mangles (see Mangles).
Pattern adjustment on Printing Machine 89
Paranitraniline Red 72–74
Piling, Automatic Machine 12, 13
Plaiting Machine 121
Plate Singeing Machine 10
Plan of Printing Works (see Plan of Bleaching, Dyeing, Printing and Finishing Works) 29, 30
Press, Hydraulic 122
Printing Machine 85–90
  ,, ,, Method of Machine Printing 85
Red, Paranitraniline 72–74
Rolling and Lapping Machine 122, 123
Schreiner Calender 114–118
  ,, Finish—Permanent Finish 118
Scutcher 21, 22, 25
Sewing Machine 6, 7
Shearing Machine 83
Singeing 6–13
Soaping, Open 96, 98-101
Souring Machine 19
Squeezer 21, 23
Stamping Machine 122
Starching Machinery 53, 102
  ,, Method of Threading on Starch Mangle 53
  ,, Back-starching of Printed Goods 105
  ,, ,, ,, White Goods 47–53
Steaming Ager 94–96
  ,, Cottage 96
Stenter Clip 109, 111
  ,, Short 56, 57
  ,, Hot-air Type 105, 109–113
  ,, Drying on 110
Tests for Dyes 79, 80
Universal Calenders 59
Vat Colour Dyeing Machinery 68, 69
Washing Machinery—Bleach-croft Type 18, 19
  ,, ,, Open Width 37, 38, 71, 76, 96, 98–101
Water 26
Water Mangle 25

TILLOTSONS (BOLTON), LIMITED,
Art Printers,
Bolton, Manchester and London.

NK

11/87

CL 3263.